PROCEEDINGS

OF THE

ASSOCIATION OF OFFICIAL SEED ANALYSTS

OF

NORTH AMERICA

1936

IMPERIAL MYCOLOGICAL
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INSTITUTE

Twenty-Eighth Annual Meeting
Rochester, New York, June 16–18, 1936
Geneva, New York, June 19, 1936

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EDITED BY M. T. MUNN
PUBLISHED BY THE ASSOCIATION
1936

Made in United States of America
Published October, 1936

W. F. HUMPHREY PRESS INC.
GENEVA, N. Y.

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1935–36

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Canada, Sackville, Andrew Hope.

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Colorado, Anna M. Lute.

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Michigan, Chas. A. Stahl.

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Vermont, Anna S. Lutman.

West Virginia, Marvin H. Snyder.

Virginia, Jennie S. Jones.

Wisconsin, A. L. Stone, Wilson Stone.

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OTHER VISITORS

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MINUTES

TWENTY-EIGHTH ANNUAL MEETING, ROCHESTER, NEW YORK, JUNE 16–18, 1936, GENEVA, NEW YORK, JUNE 19, 1936

The 28th Annual Meeting of the Association of Official Seed Analysts of North America was held at the Rochester-Colgate Divinity School at Rochester, New York on June 16–17 and 18, 1936, and at the Seed Laboratory, Agricultural Experiment Station, Geneva, New York on June 19, 1936.

The meeting was attended by 53 representatives of 25 official seed testing laboratories, 12 representatives of as many seed trade and commercial seed testing laboratories and 23 visitors including a number of seedsmen.

Local arrangements in charge of Professor M. T. Munn were such as to make it possible to conduct business very efficiently. The accommodations were exceptionally pleasing.

An interesting feature of the meeting was the Presidents' Breakfast held in honor of the Past Presidents on Wednesday morning, June 17. Mr. A. L. Stone, Mr. Edgar Brown, Mr. M. T. Munn, Miss Anna M. Lute, Mr. W. H. Wright, and Dr. C. W. Leggatt were at the Speakers' Table with Mr. W. O. Whitcomb presiding. In addition to these, messages were received from the following Past Presidents who were not in attendance:

1. G. J. Christie	5. George H. Clark	9. F. H. Hillman
2. W. L. Oswald	6. F. W. Taylor	10. O. A. Stevens
3. E. D. Eddy	7. E. H. Toole	11. W. L. Goss
4. G. T. French	8. F. S. Holmes	

The nature of the reports and the interest shown in discussion by the members indicated that the officers and committee members have been very active since the 1935 meeting. This fact, in addition to the live problem involving the accuracy of tests and the relationship of this to seed law enforcement resulted in a very interesting and fruitful meeting. The following actions were taken by the Association:

1. It was authorized that a stenographer be engaged to attend all sessions and take notes that may be referred back each day for correction or approval.

2. It was moved and carried that in the election of officers each laboratory nominate one person for each elective office; the names to be sent to the Nominating Committee as provided by the constitution.

3. It was moved and carried that the Research Committee consist of five members representing five districts of the United States and Canada; each member to serve five years after the fifth year. For the first five years the members would serve one, two, three, four and five years respectively.

4. The proposed revision of the Rules for Seed Testing was tabled for one year during which time mimeographed copies will be distributed to each laboratory for study.

5. Mr. E. Brown was asked to continue "The work on the Handbook" and to prepare one or more sections in mimeographed loose leaf form as soon as possible.

6. The proposed Uniform State Vegetable Seed Law was returned to the incoming Legislative Committee for further consideration, legal advice and conference with the seed trade.

7. It was directed that a committee be appointed to prepare standards of germination for vegetable seed.

8. Provision was made for the preparation of proposed uniform regulations under the proposed Uniform State Seed Laws which, after due consideration by interested organizations, may be adopted by the Association.

9. The Association voted to communicate to the Secretary of the United States Department of Agriculture its appreciation for the assistance in seed control in the many states accomplished under the provisions of the interstate clause of the Federal Seed Act: and that in view of the damaging effect of the increasing use of certain types of misrepresentations that do not come within the present provisions of the Act, there is a need for a revision of its provisions that will make it possible to:

(1) Institute seizure proceedings when seed is misbranded in interstate commerce in a false or misleading manner.

(2) Institute criminal proceedings against those guilty of making false or misleading representations in interstate commerce.

10. The incoming President was instructed to appoint a committee to give consideration to a Federal Statute that would require labeling of seed in interstate commerce.

11. Provision was made for the appointment of a committee to outline the minimum qualifications for seed analysts and the minimum standard equipment for an official laboratory, such standards to be presented to the director of each experiment station and to each state department of agriculture. It is planned that the standards will be presented at the next annual meeting.

12. The proposed revision of the Constitution was presented to the Association to be acted upon at the next annual meeting.

13. It was proposed that the name of the Association be changed to "Association of Official Seed Analysts".

14. The Association went on record in favor of continuing the accumulation of material for the history of seed testing in Canada and the United States.

15. The recommendations made by Mr. Goss in his Presidential address at St. Paul, Minnesota in June 1935, were returned to the committee for further consideration.

16. The Association expressed a desire to become a member of the International Seed Testing Association. Fifty dollars were appropriated to pay the minimum annual fee in event membership is accorded.

17. The Association adopted the following resolution: "It has become evident from a comparison of referee tests and further study and investigation into the matter that the so-called Stronger Method (S. M.) of arriving at a pure seed percentage being founded upon incorrect principles is not entirely practical and cannot be followed with consistency and safety by technical workers everywhere. That its use has led to confusion and difficulty because high germination percentages secured following its use are quoted alone and without reference as to how or by what method they were obtained.

It is the sense of this meeting that this Association again call to the

attention of the International Seed Testing Association the great desirability of having in the International Seed Testing Rules but one method for making a pure seed determination and that method be as close as possible to a physical purity as is exemplified in the so-called Shorter Method (Q. M.) now in the Rules. That all attempts to consider viability in making a purity analysis be eliminated. To this end this resolution is respectfully submitted to the President, the Executive Committee and the Research Committee of the International Association urging their careful and full consideration of this important matter."

18. In response to the proposals in the paper entitled "A Message to the Association of Official Seed Analysts of North America from the American Seed Trade Association—Farm Seed Group" published elsewhere among these proceedings, the Association voted to advise the American Seed Trade Association that the plans being evolved by the new Research Committee will at least make an approach toward the solution of the problems emphasized by the Seed Trade Association and that, for the present, financial aid from the Seed Trade Association may not be needful although gratefully acknowledged, but that we do desire to cooperate fully with all concerned, both the seed trade and enforcement agencies through the appointment of appropriate committees looking forward to a full and complete investigation and study of the facts underlying what are quoted as inconsistent or unreliable results.

19. The incoming President was instructed to appoint a committee to secure additional copies of the so-called "Certificate-Label Plan" which embodies "possible expansion of the seed verification service to include a certificate-label covering germination, purity and noxious-weed-seed content and dockage inspection of country-run grass and legume seeds"; that one copy be sent to each state seed laboratory for study; that suggestions for guidance in study be prepared together with a questionnaire to be filled out and returned to the committee; and that a summary of the information secured be forwarded to the Secretary of Agriculture at Washington, D. C., as representing the reaction of the official laboratories to the plan.

20. The incoming President was directed to appoint an editorial committee to reduce the proceedings of the 23rd, 24th, 25th and 26th Annual Meetings into one volume and to prepare an index for all the proceedings.

21. The Association voted to express its appreciation to M. T. Munn for his splendid services as Editor of the *News Letter* for the past several years, for the excellent arrangements he has made for the present meeting and for the opportunity of holding part of the meeting at the Geneva Station.

22. The Secretary was instructed to convey greetings from the Association to Miss Regina B. Schulte who is absent from her duties due to illness.

23. The Association resolved to express to Dr. A. W. Beaven, President, and to the staff of the Rochester-Colgate Divinity School, its sincere appreciation of the hospitality shown and the opportunity thus presented in holding the 28th Annual Meeting among most pleasant surroundings.

24. The Association resolved to express to the Crosman Seed Company, East Rochester, New York, its hearty thanks for the opportunity afforded to the delegates of having the novel experience of viewing the beautiful city of Rochester and its surroundings from an airplane.

25. The Association resolved to acknowledge the kind greetings received from President K. Dorph-Petersen and Vice-President W. J. Franck in behalf of the International Seed Testing Association; from Dr. F. T. Wahlen, Oerlikon-Zurich, Switzerland; from Hon. J. C. Holton in behalf of the National Association of Commissioners, Secretaries and Directors of Agriculture; from Mr. Joseph R. Page in behalf of the New York State Seed Association, and the past Presidents who sent messages to the meeting.

26. The Association adopted the following resolution: Be it resolved that efforts be made to secure the interest and cooperation of agronomists, crop improvement associations and other agricultural organizations, in an endeavor to call to the attention of the public in general, through publicity in various ways, the widespread use of unadapted and low quality seed.

The 29th annual meeting of the Association of Official Seed Analysts will be held in Washington, D. C., in August or September 1937. The newly elected officers are George A. Elliott, Ottawa, Canada, President; Emma F. Sirrine, Washington, D. C., Vice-President; W. A. Davidson, Washington, D. C., Secretary-Treasurer.

The appointment of the Chairmen of the following Standing Committees was announced: Research Committee, Dr. R. H. Porter, Ames, Iowa; Legislative Committee, Mr. L. N. Allen, Montgomery, Alabama; Cooperative Service Committee; Mr. F. E. Foulds, Winnipeg, Canada; Public Service, Mr. F. A. McLaughlin, Amherst, Massachusetts.

Dr. C. W. Leggatt, Toronto, Canada was appointed Editor of the *News Letter*. Prof. M. T. Munn, Geneva, New York, was appointed as a committee to edit the proceedings of the 28th Annual Meeting.

REPORT OF THE AUDITING COMMITTEE

JUNE 29, 1935, TO JUNE 1, 1936, INCLUSIVE

Balance, as of June 29, 1935		$1,913.75	
Receipts:			
Laboratory dues	$550.00		
Subscriptions to *News Letter*	21.00		
PROCEEDINGS	142.00		
Tolerance tables	1.00		
Accrued interest	7.77		
		$721.77	
			$2,635.52
Disbursements:			
Stationery	$ 42.00		
News Letter supplies	27.68		
Stamps	50.00		
Stenographer (St. Paul)	30.00		
PROCEEDINGS (1929)	232.82		
PROCEEDINGS (1935)	520.11		
		$902.61	
Balance on hand June 1, 1936		$1,732.91	
			$2,635.52

(*Signed*) W. A. DAVIDSON
(*Signed*) G. T. FRENCH

REPORT OF THE EXECUTIVE COMMITTEE

The Executive Committee, according to the constitution, consists of the president, the vice-president, the secretary-treasurer, the retiring president, the chairmen of the four standing committees, and the editor of the *News Letter*.

The personnel of this committee for the past year has been: G. A. Elliott, F. S. Holmes, W. L. Goss, R. H. Porter, L. N. Allen, W. H. Wright, F. A. McLaughlin, M. T. Munn, and W. O. Whitcomb.

The first meeting of the committee was held on June 27, 1935 at the Nicollett Hotel in Minneapolis during our last annual meeting. All members, with the exception of Mr. Porter and Mr. McLaughlin were present. The subjects which received consideration were:

1. *Publicity work of the Association.* It was decided that *The American Farm Bureau Monthly* of Chicago, *The Country Gentleman*, and *The Seed World* were desirable means of furnishing publicity.
2. *Form of Ballot.* It was agreed that the ballot should be placed in an envelope when marked by the voter and sealed by him. This envelope is to be delivered to the Secretary who in turn delivers it to the Executive Committee for canvassing.

The second meeting was held on June 29, 1935 at University Farm, St. Paul, Minn. All members were present except Mr. McLaughlin. The following subjects received consideration:

1. *Time and place of next meeting.* It was agreed to accept the recommendation of the Association to meet at Rochester, N. Y. in June 1936 at the time of the summer meeting of the A. A. A. S.
2. *Mimeographing the Longer Papers.* It was decided desirable to do this and distribute them at the time of presentation.
3. *Exchange of Speakers with other Associations.* This was thought desirable but no decision was reached.

The third meeting was held on June 15, 1935 at the Colgate-Rochester Divinity School at Rochester, N. Y. All members were present except Mr. Holmes and Mr. Goss. The purpose of this meeting was to make certain recommendations to the Association to be acted upon at this meeting. Mr. Elliott and Mr. Porter were appointed as a committee to present these recommendations.

During the year the committee advised with the officers concerning the business of the Association. In this it was found desirable to maintain a close contact with the work of the committees and to submit certain problems to the committee as a whole. The Association was kept advised as to the progress of the work through the *News Letter*. Some special committees, the reports of which will appear in the program of this meeting, were appointed.—W. O. Whitcomb, *President*.

REPORT OF THE RESEARCH COMMITTEE

The work of the research committee for 1935–36 was conducted in a manner similar to that of previous years. Three phases which received attention were referee tests, revision of rules and regulations, and preparation of a hand book. Dr. G. P. Steinbauer served as chairman of the subcommittee on referee tests, Dr. Dr. E. H. Toole acted as chairman of the subcommittee on revision of rules and Mr. E. Brown served as chairman of the handbook subcommittee. Other Association members who served on the subcommittees were W. O. Whitcomb, W. H. Wright and M. T. Munn. A summary of the work of each subcommittee is set forth below.

A. Referee Tests

Seven referee tests were conducted during the year. Each test included one or more samples that represented either a specific problem or a suggested modification of present methods used in seed analysis. In most cases each test was based on some investigational work which had been conducted by one or more seed laboratories.

Test No. 1 was a sample of barley severely infected with the scab organism, *Gibberella saubinetii*. Each sample was divided into two lots, one a check, the other treated with one per cent ethyl mercury phosphate. Both lots were grown on blotters and in autoclaved soil. Readings were made for strong, weak, dead and diseased on blotters and for strong, weak and seedling blight in the soil. The purpose of the test was to give each laboratory an opportunity to study the symptoms of barley scab on seed and of seedling blight in soil and the effect of an organic mercury dust on the scab organism and on the subsequent germination of infected seed. The average results of this test as reported by 31 laboratories together with an average of two tests in the Iowa laboratory are shown in tabular form below:

Treatment	Blotters				Autoclaved soil		
	Strong	Weak	Dead	Infected	Strong	Weak	Seedling blight
	%	%	%	%	%	%	%
Check	48.3	17.4	34.3	33.7	44.5	16.6	14.6
Treated	66.7	6.2	27.1	10.8	66.4	6.0	2.5
Check (Iowa)	53.5	10.5	36.0	44.5	54.8	7.2	15.0
Treated (Iowa)	67.2	2.8	30.0	7.5	68.8	2.8	1.0

The range in percentage strong germination of check and treated seed as reported by 31 laboratories was 14 to 66 and 54.5 to 78 respectively on blotters and 19.0 to 59.0 and 42.5 to 74.5 respectively in soil. The range in results just cited is probably due primarily to different conditions for germination and to a variation in personal judgement as to what constitutes strong or weak sprouts, infected seeds and seedling blight. All laboratories reported a higher percentage of germination for treated than for untreated seeds both on blotters and in soil.

Tests No. 2 and No. 3 dealt with the disposition of broken seeds of sweet clover, flax, sorghum and alfalfa. A comparison was made of the standard method and a modified method which consists of placing all noticeably broken seeds in the inert. The latter is placed in the germinator and for every

normal seedling that appears in the inert a correction is made in the purity using half the weight of a normal seed for every broken seed which germinates. Considerable difference of opinion existed as to what constituted a broken seed and this naturally resulted in great variation in results secured. Following the purity and germination determination the index values for each method were computed by multiplying the purity by the percentage of strong germination. The average percentage of strong germination secured by the modified method was greater for all four kinds of seed than by the old method but the average index values agreed closely for all samples. The most valuable data secured from tests 2 and 3 are the wide ranges in both purity and germination secured by different laboratories. The high and low values and the differences in extremes of purity, germination and index value secured by the old method are shown below:

Kind of seed	Values for								
	Purity			Germination			Index (P x G)		
	High	Low	Dif.	High	Low	Dif.	High	Low	Dif.
	%	%	%	%	%	%	%	%	%
Sweet clover	96.0	87.2	8.8	88.5	45.3	33.2	77.8	41.5	36.3
Flax	92.9	87.9	5.0	80.0	43.5	36.5	73.1	39.4	33.7
Sorghum	93.9	88.3	10.6	75.0	33.8	41.2	69.8	32.6	37.2
Alfalfa	98.0	87.5	10.5	79.8	55.0	24.8	79.8	49.3	30.5

For comparison with the above data the averages of all tests (old method) are as follows:

Kind of seed	Purity	Germination	Index value
	%	%	%
Sweet clover	93.2	63.8	59.1
Flax	91.2	66.4	60.6
Sorghum	95.6	59.7	57.0
Alfalfa	90.0	68.1	61.7

It is evident from the above results that a comprehensive study of the causes for such wide differences is needed.

Test No. 4 dealt with the germination of frosted oats and crested wheat grass, *Agropyron cristatum*. Twenty-five laboratories participated in this test. Many laboratories had had no previous experience with either kind of seed, hence this referee test was of decided educational value. The averages of all results together with the high and low figures are presented below:

Results	Frosted Oats	Crested wheat grass			
		20–30° C.		Prechill 10–17° C. Transfer to 20–30° C.	
		Blotters	Soil	Blotters	Soil
	%	%	%	%	%
High	96	80	70	77	75
Low	71	13	9	24	12
Difference	25	67	61	53	63
Average	90	55	46	61	52

Test No. 5 dealt with the germination of broken or abnormal fruits of small ragweed and green foxtail. Fruits of ragweed were divided into three classes, namely, normal, involucre absent, and pericarp absent. Foxtail fruits were of two kinds, with and without hulls (lemma and palea). Twenty-two laboratories engaged in this test. The tests were made on blotters, the results of which may be misleading because injured seeds which sprout on blotters are frequently incapable of producing normal seedlings in soil. All laboratories secured a higher percentage germination of normal than of hulled foxtail fruits and all but one secured a higher germination of normal than of abnormal fruits of ragweed. The averages are for foxtail 76 and 21 per cent, for normal and hulled respectively, and for ragweed, 27, 6 and 6 per cent respectively for normal, involucre absent and pericarp absent. These data further substantiate those reported by Wright in the *News Letter* (March, 1936), namely that abnormal or injured ragweed seeds possess little or no viability. Hulled foxtail fruits possess about one-fourth the viability of normal fruits. It would seem that recognition of this condition should be given in some way by the Association.

Referee test No. 6 was a comparison of germination secured with flax and red clover between blotters and in soil and sand. In most cases a 50 mesh sand purchased from the Ottawa Silica Company of Ottawa, Illinois, was used in order to provide a uniform medium. Twenty-two laboratories participated. The purity results were remarkably uniform for both lots, but variations in germination were greater than the tolerance allowed by the Rules. A summary of the data secured is given below:

Medium	Percentage germination	
	Red clover	Flax
Sand		
High	80.8	87.8
Low	58.5	46.0
Difference	22.3	41.8
Average	72.1	71.1
Index average	71.5	66.6
Soil		
High	74.5	80.8
Low	44.5	59.0
Difference	30.0	21.8
Average	68.5	72.5
Index average	67.5	68.7
Blotters		
High	83.8	86.0
Low	59.5	49.0
Difference	24.3	37.0
Average	72.7	71.6
Index average	71.9	71.6

The data show a remarkably close agreement on the average and for most laboratories between sand and blotter tests with the red clover sample. The average germination in soil was nearly four per cent less than in sand or on blotters. This difference must be discounted somewhat, however, by the fact that only 14 laboratories reported tests in soil. The above differences were

not secured with flax. The use of sand as a medium to check with blotter tests has possibilities and should receive more attention in the future.

The final referee test, No. 7, was one which compared the standard method of blue grass analysis with a modified and shorter method developed in the Iowa laboratory and described in the 1935 Proceedings of the Association. Briefly, the modified method involves a series of steps as follows; (1) the weighed sample is blown in a Leendertz or other blower for 10 minutes at 21 or other opening found by experience to remove most of the empty glumes, (2) all weed seeds and other crop seeds are removed by hand from either the heavy or light portions, (3) pieces of stones, dirt or straw which the blower did not blow over are removed by hand from the heavy portion and placed in the "inert", (5) the inert material is placed in the germinator in a Petri dish or glass tray, (6) for every normal blue grass seedling which appears in the inert portion, ⅔ the weight of an average seed is added to the pure seed which increases the purity percentage, and (7) the index value, Purity x Germination, is determined on the basis of corrected purity and actual germination. Three important features of the method are (1) considerable time is saved, (2) a check on the inert is made for viable seeds, and (3) with a constant speed motor repeated tests of the same sample give uniform results because the personal factor which enters in determining empty glumes is eliminated.

A high quality sample of blue grass was secured and two representative lots were sent to each association laboratory. Sixteen laboratories responded and reported the results secured by the two methods. The data are presented below showing the averages, high and low values, and differences in extremes.

Method	Purity					Germination				
	High	Low	Difference	Average	Time req.	High	Low	Difference	Average	Index value
	%	%	%	%	Min.	%	%	%	%	%
Old method..	93.32	88.13	5.19	90.52	92.3	91.0	75.75	15.25	83.3	75.45
New method.	93.05	85.96	7.09	90.85	50.8	91.0	63.5	27.5	83.2	76.01

The above results show exceptionally close agreement between the two methods in averages of purity, germination and index value. It is believed that if uniform, constant speed motors were installed in every laboratory, more uniform results in purity determinations would be secured by the modified method than by the old method.

B. REVISION OF RULES

The subcommittee on revision of rules and regulations worked hard and faithfully. Changes in the old rules were made which should bring the rules up to date. New information concerning the testing of certain seeds of flowers, vegetables, and grasses, dormancy of seeds and its determination, and measuring the reliability of tests, is embodied in the purposed revised rules. An attempt to define germination in terms of laboratory technique and practice is made which is a decided improvement over the uncertainty which has existed for some time. The report of the subcommittee was mimeographed and distributed to members of the Association for study during the coming year.

C. HANDBOOK

The handbook subcommittee prepared an outline of the general headings and detailed topics to be covered in a handbook. The work is to be continued by the same subcommittee for 1936–37. This phase of our work is important and when the handbook is completed it will be of great assistance to all groups and classes of analysts and will help to make our methods more standard and uniform.—R. H. PORTER, *Chairman.*

REPORT OF CHAIRMAN OF SUBCOMMITTEE ON "RULES"

Full cooperation has been given by the other members of the Subcommittee, by my colleagues in our own laboratory, and by many members of the Association. However, of necessity, a first draft of a proposal of this kind is largely the viewpoint of one person. It is now up to the Association to study these proposals and develop a final form that will represent the viewpoint of the Association as a whole.

In the beginning it was not intended to make such a drastic revision but changes in one part made other changes desirable until it seemed best to rearrange the entire material. There are, however, not as many changes in essential principles as might appear from the changed form.

It has been realized before that our "Rules" include much material that is not definite enough for such a term. It seemed desirable to recognize this more fully in changing the title and by dividing the text into two parts—definite rules and recommendations. I see disadvantages as well as advantages in this treatment but leave the matter to the Association for final decision.

It should be noted that Part I deals only with the "Standard Analysis"—i.e., a determination of percentage composition, noxious weed content and germination of pure seed. Other types of analyses are treated in Part II.

Part I has been made as concise as seemed consistent with clearness while an attempt has been made to make Part II informal and helpfully informative. On the other hand, it seemed important to keep Part II brief enough for convenient laboratory use.

The answers to the questionnaires sent out by Mr. McLaughlin and letters received directly have been studied carefully. This information has proved very interesting in showing the many individual problems faced in the different laboratories and the manner in which these laboratories have adapted their work to fit their own problems. It has, in most cases, not been possible to incorporate these suggestions directly because the "Rules" must be a general guide for all laboratories, but the suggestions have been kept in mind and have influenced the presentation.

There are some specific points of departure from the old rules that need comment.

PART I—RULES

The weight of working samples has been criticised more frequently than any point. After much consideration of this matter no changes have been suggested. This sample is designed for an analysis on which to base law enforcement work and it does not seem safe to recommend smaller amounts for this purpose. If any analyst feels that under his own conditions it is safe to use smaller samples he, of course, may do so on his own responsibility.

The definition of pure seed has been discussed a great deal in our Association meetings. There is apt to be confusion in such discussion between what is desirable for law enforcement and what is practical in carrying out actual laboratory analyses. Since in general it is not possible to make variety determinations from the appearance of the seed in the purity laboratory, it seemed more practical to definitely recognize this and to make the purity separation on the obvious kind or species and then if desirable make a further determination (identification) on the non-varietal pure seed. It is important to state in the record and on the report whether such further identification was attempted. This arrangement would make advisable the inclusion on the report of a space for identification and a recognition on the label that purity percentage is non-varietal.

In connection with the definition of inert matter the Association has often discussed the proper disposition of attached sterile glumes of grasses. No recommendation for a change has been made on this point but it may be pointed out that proviso 2 allows for some leeway in the interpretation of this question.

The definite "Rules" that can be made concerning germination are limited. The most important is a declaration of attitude about interpretation expressed as a definition of germination. It should be noted that the definite requirement of at least 400 seeds for germination tests applies to the standard analysis which is discussed in Part I.

Although there is much sentiment in favor of using the international tolerance for purity no change has been included in the draft presented. The germination tolerance has been changed for the range between 90 percent and 100 percent.

PART II—RECOMMENDATIONS

It has been suggested that in Table I the ranges of size of seed be given. Because of the indefiniteness of what might be considered proper ranges of size, it seemed more advisable to continue the average figures. Numbers per ounce have been listed as well as numbers per gram.

Under noxious weed content there has been added a discussion of the variability to be expected together with a new table. It is hoped that this will be helpful in a better understanding of the problems encountered in determining noxious weed content.

The evaluation of weed seeds needs further discussion by the Association before definite formulation in our rules.

Some variations from the standard analysis that have been found useful are suggested.

The material on germination has been rearranged and amplified to some extent in the hope that the information will be more helpful in meeting the many complex problems in a germination laboratory. The different conditions in different parts of the continent and in different laboratories have been kept in mind. Because of these varying conditions, it is felt that recommendations must be general rather than specific. The material in the germination table has been rearranged to bring the information of the footnotes into a column of remarks.

Mr. M. T. Munn has kindly furnished the material for the last two sections,— F. Determination of moisture content and G. Determination of seed borne diseases.

If the Association feels that this draft of a revision can serve as a general basis for new "Rules" it is recommended that a committee by appointed, the members of which will be able to meet together to consider changes that may be suggested by members and discuss disputed details and recommend a final form which can be acted upon at our next meeting.—E. H. TOOLE.

REPORT OF THE COMMITTEE ON HANDBOOK

There has been no very clear picture of the character of the Handbook as to whether it should be in the nature of expanded rules or a modern "Samenkunde". The revision of the rules for seed testing as presented by your committee includes pertinent comment and suggestions which will be most helpful in the application of the rules. It, therefore, seems that the handbook should be made up of a series of chapters treating comprehensively the various phases of seed testing. With this in view, there has been drafted a table of contents and outlines.

With the cooperation of the various persons in the Association who are most familiar with the special subjects, it is believed that a helpful handbook will result. If the present committee on handbook is continued, the members of the Association will be called upon to present the work of their special fields. Then chapters can be distributed through the *News Letter* for comment before finally being incorporated in the handbook.—E. BROWN, *Chairman*.

REPORT OF THE COMMITTEE ON COOPERATIVE SERVICES

The first action taken by this committee shortly after appointment was to publish a list of seeds for exchange by 20 laboratories belonging to the Association. This excellent list was prepared by Mr. F. A. McLaughlin of the Massachusetts laboratory. Fortunately it was possible to have this printed, through the courtesy of the Publications Branch of the Dominion Department of Agriculture.

The committee has made an attempt to obtain the opinions of members of the Association concerning the proposal that regional meetings might advantageously be held from time to time. In order to obtain the required information a questionnaire was sent out to 48 laboratories, and 35 replies were obtained. An attempt has been made to summarize these replies:—

Q. 1. Have you been able to attend the annual meetings in the past with any regularity?

Yes—12 (This includes one or two who attended 75% of the meetings.); *Occasionally*—3 (i. e. 50% of the meetings.); *No*—20; *Not answered*—1.

Q. 2. Do you consider regional meetings desirable?

Yes—27; *No*— 3; *Doubtful*—5. Among the doubtful answers two definite statements were made: "If not held every year," and "If the annual meetings become biennial".

Q. 3. Would you be able to attend regional meetings with regularity each year?

Yes—1; Yes, at my own expense—1; Yes, in summer—1; Total—3; If within reasonable distance of my own laboratory (200 miles the limit for one member)—13; Doubtful—8; Doubtful, but with better chance than of attending the annual meeting—4; No—9; No reply—3.

Q. 4. Do you think there would be danger of the regional meetings lowering the attendance at the annual meeting?

Yes—23; (Type of reply: "Yes, if the regional meetings were well attended", "Annual meeting might be more useful", "Yes, if distance to annual meeting is too far".); Doubtful—1; No—7; Not answered—4.

This summary brings out some rather interesting points. First, it is rather amazing that only 12 laboratories have been able to send representatives to the Annual Meetings with any regularity. The committee is confident that it is not due to apathy on the part of the official analysts, but rather to the unfortunate circumstance that governments are not interested in seed testing, or are perfectly satisfied with the work already being done; or, again, cannot see the value of allowing their employees to exchange ideas with other analysts.

Twenty-seven members stated that they considered that regional meetings would be desirable. Twenty-three feel that such meetings would most likely cut down the attendance at the Annual Meetings, which means that they consider that if regional meetings are held, interest in the Annual Meeting would wane; or that authorities will allow them to attend only one meeting each year.

Only 16 members feel that they would be able to attend regional meetings with any degree of certainty, if they were not called upon to travel too far from their headquarters.

In some areas much good might be derived from Regional Meetings if they were properly organized. In each region one person possessing energy and perseverance would have to take the lead and work up enthusiasm. It would be most advantageous if this person could visit, not only the official analysts in his area, but also the heads of departments or those who have the say in the spending of money for travelling.

There is the possibility that the Annual Meeting would become a meeting of regional delegates, should regional meetings prove to be successful. As soon as regions are established, regional chairmen and secretaries will be appointed. Regional expenses will be incurred, and before long regional groups, quite reasonably, would be requesting the refund of a small part of the annual fees in order to meet these expenditures.

This committee is unable to make any definite recommendations either for or against regional meetings, but it considers that much interest has already been created, and that the question must not be allowed to drop; and recommends (1) that the incoming president and executive divide the States into regions and appoint one man in each region to further investigate the possibilities of holding regional meetings every second year; and (2) that the executive committee consider the advisability of bringing before State authorities the importance of the work being done by the Association. It should point out that official seed analysts are furnishing information for officers enforcing laws, and that the uniform and fair enforcement of these laws depends to a great extent on the uniformity of the work done in the various state laboratories. Great strides have been made towards obtaining the desired uniformity by the Association through the medium of referee tests, but still greater progress would be made if at least one analyst from each laboratory were permitted to attend the Annual Meetings.

The committee quite realizes that favourable response to this appeal might be disappointing. However, the Association will not gain anything without effort.

If this appeal is fruitless, then the Association can concentrate on the proposal to hold regional meetings.—W. H. WRIGHT, *Chairman.*

PUBLICITY AND EDUCATION IN METHODS OF SEED CONTROL

In February 1936 a questionnaire was sent to each of the laboratories of the Association and to several of the Departments of Agriculture to learn what means were being taken by the various states in giving publicity to the work of the laboratories. At the present writing, replies have been received for fifty-five of the fifty-seven questionnaires originally submitted. In some instances, questions were not answered or, if so, were only partly replied to, but in general the replies were complete and many helpful suggestions were made. The questions with their replies are as follows:

1. *Have you made any effort to contact your public?* (Thirty-nine answered "yes," whereas three qualified their replies to the effect that very little effort was made.
2. *Have such contacts been spasmodic or continuous?* (Twenty-eight replied that the contacts were continuously being made, and twelve, spasmodically.
3. *Which of the following have you used: bulletins, press releases, radio, local meetings, exhibits, publication of analyses of officially-collected samples? Are the results of all tests published?* Twenty-six of the laboratories used bulletins; thirty employed press releases; twenty-five radio addresses; twenty, local meetings; eighteen, exhibits and twenty-one the publication of analyses of officially-collected samples. Fifteen publish the results of all tests.
4. *To what extent have you used them and how frequently are they issued?* Fourteen publish their bulletins annually; one, semi-annually; two, monthly; three occasionally. Three laboratories issue press releases weekly; two, monthly and five occasionally. Nine have radio addresses given several times a year. Six laboratories hold local meetings several times each year. Six set up exhibits several times a year besides several more, which exhibit from time to time at state fairs.
5. *Which have you found to be most effective?* The opinion as to the effectiveness of the various methods differs, since very few of the laboratories have been using all types of publicity and consequently can only judge from results gained by the particular method used.

   Five believe that bulletins are most effective; twelve find press releases the best; two judge the best results are from radio talks; eight are most enthusiastic about local meetings; four vote for exhibits of one kind or another and six find the publication of analyses of officially-collected samples bring about the desired results. Four laboratories bring out a point not touched upon in the questionnaire; namely, that personal contact has been most desirable.
6. *Do the extension people take an interest in the seed work?* Opinion seems to be very strongly in favor of cooperation with the Extension Services. Thirty-three answered "yes" in the replies to this question. The following types of service are given by the various Extension Services of the country: (a) Conduct field demonstrations; (b) Educational work; (c) Contact the farmers; (d) Recommend submission of samples for testing; (e) Make rules and regulations to assist in the better distribution of seed.

   The following notes will provide suggestions for cooperation and relate the experiences of authorities in several states who replied in detail to this question.

   In Michigan, the Extension Department cooperates with the Michigan Crop Improvement Association in sponsoring a better seed program.

   In Virginia, county agents devote considerable time to furthering production of better seed. They also emphasize, as far as practicable, the value of tags showing complete analysis of seed offered for sale, though it is felt that much emphasis might be placed upon the conformity of tag statements with requirements to the law.

   In Ohio, the State University cooperates with the Ohio Seed Improvement Association and the Department of Agriculture in promoting constructive legislation.

   In Iowa, the laboratory work is under the direction of the Extension Service which purchases supplies, furnishes extra labor and conducts all the educational work. Two men are regularly employed by the Extension Service for field work, carrying an educational program to the people in weed, seed and disease control.

In Wisconsin, the Extension agronomists aid in publicizing seed and weed control work. The Crop Extension men in the Department of Agronomy also deal with these subjects at many of the local farmers' meetings throughout the state. Identification of seeds and weeds is taught in each of the 4-H Clubs.

In Canada, province workers in Extension Service take a very great interest in the seed work. In every province the Boys' and Girls' Clubs, in their programs, give a great deal of attention to the study of seeds and participate in judging exhibits, held in various places every winter.

The Extension Service in California promotes the use of seeds—particularly of small grains, beans and rice of approved varieties which have been grown from foundation seed furnished by the University of California.

7. *If the Extension people are not interested in the seed work, how could their interest be obtained?* A very few answers were submitted to this question. Those who did reply seemed to favor larger appropriations and greater effort to enforce the seed law.

8. *How many inspectors do you have?* Replies show that thirteen of the states have one full-time inspector and one or more short-time or seasonal inspectors. Six states employ two; five states, three; four have four; one has five; two have seven; three have eight; one has nine; two, twenty-five and the Dominion of Canada, fifty. Although it isn't so stated in replies to the questionnaire, one is lead to interpret replies from states having a large number of inspectors to mean that many of them, at least, are employed for only a portion of the year.

9. *Do they undertake educational work as they contact the public?* Twenty-nine of the laboratories reply that their inspectors are instructed to carry out as much educational work as possible while occupied in field or official sampling work. Eleven of the states have replied that inspectors are instructed only in the drawing of samples and the examination of tags for conformity with the state law.

10. *What is the present sentiment in your state or province concerning the seed control service?* Thirty-three replies indicate that control service is favored by the farmers and dealers. Two reply that the public is slightly interested and three frankly state that sentiment is indifferent.

11. *Is it sufficiently favorable to see that you are given proper financial support?* Twenty-four of the laboratories indicate that their problem is largely a matter of finance, whereas sixteen believe that proper financial assistance is only basic.

12. *What financial support do you now receive?* Amounts received for control work in the various states vary from $500, in one of the smaller states, to $500,000 in Canada, which is an appropriation for all seed, feed and fertilizer work.

The following table indicates amounts appropriated by the various states, laboratories for which have replied to this question. There is evidence in some cases that the amounts appropriated are for laboratory maintainance only and in other instances the amounts shown is the total appropriation for work of the laboratory and the State Department of Agriculture.

$500	Rhode Island
600	So. Dakota
1000	New Hampshire and Iowa
2000	Nevada
3000	Missouri
4000 to 5000	La., Ark., Mont., Col. and Kan.
6000	Massachusetts
8000 to 10,000	Ind., Mich., Neb., Okla. and Minn.
12,500	Wisc. and Texas
16,000	Ohio
20,000	Calif., Virginia
21,000	New York
500,000	Canada (Includes seed, feed and fertilizer)

13. *If the sentiment is not now favorable, what effort do you intend to make to change it and what methods will you use?* Replies to this question may be generalized as follows: In a very few of the states, present sentiment is all that could be expected and therefore no changes or new methods are recommended. Other replies indicated desirability for larger appropriations for seed work, revision of existing state seed laws, enlarging publicity campaigns, better Extension cooperation and rigid enforcement of seed laws now in effect.

14. *What sort of a mailing list do you maintain?* The following table summarizes effectively the replies to this question:

Farm Bureau	Seed dealers, 28	Experiment stations, 2
Extension Service	Farm press, 2	County agents, 5
Out-of-state wholesalers, 2	Smith-Hughes instructors, 3	

15. *Would you participate in a joint program to secure publicity for your work?* Thirty-four replies to this question indicate that twenty-nine would be interested in a co-operative program and five are "not interested." It is assumed that the five who replied in the negative to this question are entirely satisfied with the results secured by programs now in effect.

In reading over replies to the questionnaire, it is encouraging to note that thirty-four states desire to adopt a program of leadership. It is also evident that a large number of the laboratories are very active, and that in such instances, constructive leadership is operating to the advantage of those laboratories at the present time.

On the other hand, it is apparent that many states are inactive or nearly so; that is, a lack of leadership with no program designed to bring about cooperation between producers and consumers of seed and the various agencies which are set up in each state to further such cooperation.

Based on replies to the questionnaire, your committee offers the following recommendations for your consideration:

1. Adequate financial support must be secured. No project which affects the public will be given financial support unless supported by public opinion. To arouse public opinion, work of the seed laboratories must be given publicity. It is recommended that any seed laboratory which is not now publicizing its work begin at once to do so.

2. Every available form of publicity should be employed. These include daily and weekly press releases; radio talks; addresses and discussions at various kinds of meetings; exhibits at fairs and the publishing of analyses of seed made at the seed laboratories.

3. An effort should be made to correlate the various agricultural interests of the state in producing a cooperative seed program. Extension workers, particularly Extension agronomists, by the very nature of their work, are in a very strong position to be of assistance.

4. Inspectors employed by the state departments, or laboratories, should be thoroughly trained in laboratory methods. They should be put in a position to carry out programs which have been formulated by the laboratories in the education of seed dealers and the public to sell and demand clean and vital seed, free from noxious weeds and labelled in conformity with laws of the various states.

5. An extensive mailing list is essential to an effective publicity campaign.

6. Cooperation between all agricultural interests of any state should be attained by whatever method or methods, after trial, have been found the most effective. Cooperation should not cease within the state itself, but should be extended in many instances to include workers in other states. Laboratories which have not attained the degree of cooperation which is desired will do well to study and adopt methods of the several states which have been successful in securing public approval and interest and with this approval, the support of legislative bodies who have provided strong financial support.—G. T. FRENCH, A. L. STONE, F. A. MCLAUGHLIN.

REPORT OF THE LEGISLATIVE COMMITTEE

Members have been supplied with mimeographed copies of the Proposed Uniform Vegetable Seed Law drawn up in accordance with the sentiments expressed by the Association at its 1935 meeting in St. Paul.

A copy of this proposed law was submitted to the Seed Trade and met with opposition only in so far as Section 2 was concerned. This section calls for a statement of the percentage of germination and date of test on all containers of vegetable seeds sold, offered or exposed for sale. The Seed Trade, through their Legislative Committee, strenuously objects to the provision in this form and stated a number of reasons why it would not be acceptable to them.

The Legislative Committee of the two Associations, therefore, tried to reach an agreement. In order to do this, it was necessary that we meet on a common ground and that some consideration must be given by each committee to the wishes of the other association. This involved an apparent sacrifice of certain principles which were desired by each association to be incorporated in the Law. The Committee feels that a greater effort should be made to reach an agreement on a uniform state vegetable seed law and, therefore, presents to this Association a form that will be satisfactory to the Seed Trade. This form, while not the same as that included in the mimeographed copy of the Law presented to you, can serve as satisfactorily as one requiring the definite germination percentage on all types and sizes of packets and packages of garden seed. It would require the statement as to germination and date of test on all packages of one pound or more; it would require the setting up of a standard for germination of vegetable seeds and the labeling of packets of less than a pound with a statement to the effect the seed germinates above the standard. The wording on the packet would be definite enough to permit filing of action under Section 6 of the Federal Seed Act when misbranding occurs. It will also be definite enough to permit legal action to be taken in any state in which this law is enacted. This meets with the approval of the legislative committees of the Association of Official Seed Analysts and the American Seed Trade Association.

The Committee wishes to present the following recommendations for consideration and action of the Association:

1. That the Proposed Uniform Vegetable Seed Law be adopted in the sense as given with the qualification that the Legislative Committee be permitted to make alterations in the wording that would not change the sense but would meet objections called to its attention by the Legislative Committee of the Seed Trade.

2. That a committee be instructed to prepare proposed uniform regulations under the Proposed Uniform State Seed Laws which, after due consideration by interested organizations, may be adopted by this Association.

3. That this Association communicate to the Secretary of the United States Department of Agriculture its appreciation for the assistance in seed control in the many states accomplished under provision of the Interstate Clause of the Federal Seed Act; and, that in view of the damaging effect of the increasing use of certain types of misrepresentations that do not

come within the present provisions of the Act, there is a need for a revision of its provisions that will make it possible to:

1. Institute seizure proceeding when seed is misbranded in interstate commerce in a false or misleading manner.

2. Institute criminal proceedings against those guilty of making false or misleading representations in interstate commerce.

4. That a committee be appointed by this Association to prepare standards of germination for vegetable seed.—L. N. ALLEN, *Chairman.*

REPORT OF COMMITTEE ON RECOMMENDATIONS BY W. L. GOSS IN PRESIDENTIAL ADDRESS, ST. PAUL, 1935.

This committee did not have sufficient time to go as fully as possible into the recommendations made by Mr. W. L. Goss, past president, and offered at the time of his retiring from this office. We have, however, been able to contact, through correspondence, a number of members of the Association in regard to his recommendations. This committee has at its disposal a copy of the results obtained in replies to a letter directed by our president, Mr. Whitcomb, to the members of the Executive Committee. There are in addition for consideration replies from eight states. These replies represent a fairly good cross section of the country.

In order to have a better understanding of just how to present this to the Association, a letter was directed to Mr. Goss requesting an expression from him as to just what he had in mind upon presenting these recommendations to the Association. In reply Mr. Goss stated,—"It was my idea in making the recommendations that the points covered be given consideration by the Association and whether or not they were acted upon would be left to the discretion of the Association."

In summarizing, one finds the following results which indicate the opinions of the various members of the Association in regard to these recommendations. Eight replies were received in response to requests from this committee.

RECOMMENDATION No. 1.—"Actual value should accompany a report of germination samples previously analyzed for purity, and germination test on seed of low purity should not be made without a previous approximation of purity." Each of these eight expressed himself as in favor of the adoption of No. 1. In addition, replies from seven members of the Executive Committee indicate a similar attitude. This makes a total of fifteen favorable to this first proposal with no objections.

RECOMMENDATION No. 2.—"Reports should not contain statements or inferences which are misleading or which may be construed to mean more or less than is intended." Similarly, replies were received for No. 2, no objections being voiced to this recommendation.

RECOMMENDATION No. 3.—"Variety testing in connection with enforcement of vegetable seed law indispensable. Such work might best be performed by Federal Government at perhaps 3 or 4 stations." In regard to No. 3, there again was accord but some difference of opinion as to how such a problem might be handled and some question was raised as to its practicability.

RECOMMENDATION No. 4.—"Date of germination test on label adds to difficulty of enforcing law. Recommend that this practice be discontinued." Recommendation No. 4 became a very debatable one. Of the replies received, the expressions were about equally divided for and against the change. The test date was considered of great importance by some, but of no importance by others.

RECOMMENDATION No. 5.—"Examination of entire official sample and listing of kinds of weed seeds found, together with percentage of germination, is often of greater value and requires less time than the detailed purity test of a small sample with the examination of the recommended bulk for noxious weed seeds only." In regard to recommendation No. 5, it would seem that this became a debatable subject also, about 50% expressing themselves in favor of consideration and an equal percentage being opposed.

You have been given a summary of the replies to letters from various members of the Association regarding these regulations. It would seem to this committee that Nos. 1, 2, and 3 might be acted upon favorably, while Nos. 4 and 5 might be given more consideration by the Association. Since this committee does not wish to offer a recommendation, we are leaving the matter up to the Association and request an expression as to what consideration the Association wishes to give these recommendations.

In conclusion one might quote at this point Mr. Goss's opinion in regard to these recommendations:

"It appears to me that if recommendations 1 and 2 are approved by the Association, the ideas incorporated in these recommendations might well be made part of the revised Rules for Seed Testing."

"It was my idea with recommendation 3 that, if approved by the Association, it could be followed up by a recommendation of the Association made to the U. S. Department of Agriculture recommending the establishment of the trial grounds with recommendations giving the advantages which would accrue to the consuming public as a result of a more thorough check up on the trueness to name of seed offered to the trade."

"Recommendation 4 is a recommended change in the seed law requirements and one apparently not being approved by most of the analysts. In my letter to you relative to the vegetable seed law, I stated my reasons for recommending this change."

"In presenting recommendation 5 I had in mind calling to the attention of the Association what appeared to me to be a lot of unnecessary work which is being done by seed analysts in checking in minute detail label statements appearing on seed in which small variations were of no practical benefit to the planter. The presence of noxious weed seeds, however, even in very small quantities, is being looked upon more seriously as the different states are paying more and more attention to the eradication of noxious weeds."

(At this point the discussion became open and the Association proceeded to act on these recommendations.)—F. A. MCLAUGHLIN.

HISTORY OF ASSOCIATION OF OFFICIAL SEED ANALYSTS

ANNA M. LUTE

Agricultural Experiment Station, Fort Collins, Col.

The Association of Official Seed Analysts seems to have been interested in its own history from the first. It has now, however, been 17 years since we have published pertinent facts of our history so perhaps the best form for this report to take is a brief resumé of five previous historical papers on our Association and a bringing up to date of our activities. The authors of these papers are the following, all but one of whom are still active in our Association.

J. P. Helyar—1914
A. L. Stone—1915
G. T. French—1918
E. Brown—1919
E. Brown—1921

From these five published papers and some additional notes sent by Mr. Brown, it is a matter of record that in interests, if not in organization, the Association of Official Seed Analysts of North America had a predecessor.

Probably the most outstanding piece of work accomplished by our Association is the working out of Rules and Regulations for seed testing. Our predecessors in interest, if we may so call them, published suggestions of this kind as Circular 34, Division of Botany, United States Department of Agriculture.

At the tenth annual meeting of the Association of American Agricultural Colleges and Experiment Stations, November 1896, Gerald McCarthy, Botanist of the North Carolina Experiment Station presented a memorial signed by directors of 37 Experiment Stations requesting that association to appoint a committee to devise and adopt a standard form of seed testing apparatus and method of procedure for use in all American Experiment Stations which carried on seed testing work, with a view to encouraging cooperation between United States Department of Agriculture and Experiment Stations.

The committee appointed consisted of:

G. H. Hicks, Botanist in Charge of pure seed investigations, Division of Botany, United States Department of Agriculture, E. H. Jenkins, Vice-director, Connecticut Experiment Station, G. McCarthy, Botanist, North Carolina Agr. Exp. Station, F. W. Card, Horticulturist, Nebraska Agr. Exp. Station and W. R. Lazenby, Professor of Horticulture, Ohio State University.

This committee sent a circular letter to all Experiment Stations asking for suggestions as to methods and equipment. From the 25 replies received they formulated suggestions for equipment and methods.

The following year, 1897, the report was presented, adopted and recommended for trial by all states in which seed testing was carried on. It contains drawings of a design for a standard chamber which is to be used for seeds, bacteria, physiological work, etc. It provides for heating but not for cooling. This appears to be the design from which the later Standard chamber made by Kny-Scheerer was built. It also contains a discussion of methods of sampling, size of sample, length of time for germination for various seeds. A note suggests that mixtures are too hard to do and take too much time and recommend they be not tested.

One provision which the intervening 40 years and experience in seed law enforcement makes us appreciate even more than they did, is the following: "Each sample submitted for test should be accompanied by a sworn statement that it is a fair sample drawn according to directions".

At the 16th annual convention of the same association, i.e., Association of American Agricultural Colleges and Experiment Stations, a committee was appointed to revise Circular 34.

Jenkins, Lazenby, and Card of the Original committee were on this second committee. E. Brown, and A. D. Shamel were the other two. (Mr. Hicks of the previous committee had died in the interim.) The revised report was adopted in 1903. In 1904 Dr. Jenkins announced that the revised rules had been published. The Association of Agricultural Colleges and Experiment Stations apparently took no further action in regard to seed testing. The United States Department of Agriculture again revised circular 34 in 1906.

In December 1908, a meeting of Experiment Station and Agricultural College workers interested in seed testing was called at the Department of Agriculture in Washington, D. C. Sixteen states, the U. S. Department of Agriculture, and the Department of Agriculture of Canada were represented. At this meeting an organization of those officially interested in seed testing was formed. It was to be known as The Association of Official Seed Analysts. The object of the Association was to be the perfecting and *promulgating of uniform methods for seed testing*. Committees were appointed to revise the *Rules and Regulations for Seed Testing* and to work on a model seed law, the object of both rules and law being greater uniformity.

The second meeting in Boston, 1909, received and adopted the report as to purity testing. The report as to germination was adopted as a report of progress.

The committee to whom the formation of a model seed law had been delegated presented a report based on joint deliberations of the committee and a committee of the American Seed Trade Association.

In 1910 at the third meeting, the constitution was adopted. It gave as the purpose of the Association of Official Seed Analysts to secure uniformity and accuracy in method, results and reports.

From 1908 to 1911 inclusive, discussions appear to have been largely informal.

The 1912 and 1913 meetings started the presentation of papers. It was then thought advisable to publish the proceedings but the voluntary contribution of $5.00 per state did not meet with unanimous response. Funds accumulated were insufficient to finance a publication.

Mr. Helyar, who was elected secretary for 1914, says that for carrying the activities of the association through these first six years we are deeply indebted to Mr. E. Brown, the secretary 1908–1913 inclusive.

CONSTITUTION.—The purpose of Association of Official Seed Analysts in 1908 was set forth as "to promulgate uniform methods for seed testing".

The first constitution was adopted in 1910. To the original purpose, (1) uniformity, was added a second, (2) to afford opportunity for discussions of matters of interest to seed analysts.

It also stated qualifications for membership. Really the same as at present, that is, official analysts. It limited votes to one for each laboratory and provided for designating as honorary members those who retire from official position.

It provided for a referee for each subject to be considered by the association.

Beginning with the first Proceedings of the Association of Official Seed Analysts in 1914 detailed information as to interest and activities of the Association are available.

1. METHODS—purity and germination

Referees on methods were appointed in 1910. The first published report of this activity was made in 1915; annual reports of the work of such a referee have been made since that time.

2. LEGISLATION

Uniform seed legislation was first considered in 1908, the first meeting, by the appointment of a legislative committee. This committee reported in 1909.

Principles of a Uniform seed bill for field seeds were proposed in 1915, modified in 1916 and adopted as a Uniform seed bill in 1917. In 1919 proposals for an interstate seed act and for a vegetable seed law were initiated. These continued to be discussed and modified. In 1921 the addition of a seizure clause to the Uniform bill was proposed.

A suggested uniform vegetable seed law was formulated in 1922.

In 1926 the passage of the interstate seed act was announced. Seed Legislation appears to have been discussed at each meeting except 1918, a year of rest, apparently, after the adoption of the Uniform Bill in 1917

3. APPARATUS FOR SEED TESTING

The first revision of Circular 34 was published in 1904. This contained illustrations of two types of samplers, a mixer, sieves, vertical air blast and a germination chamber. Discussion of equipment has been continous since that time, with emphasis on aids for making separations in purity analyses and for maintaining uniform conditions in germination.

The seed counter was first suggested in 1916, perfected in 1928.

Other interests which have occupied time and attention altho not so consistently reported upon are the following:

1. Packet vegetable seeds beginning in 1916
2. List of seeds for exchange beginning in 1916
3. Law enforcement beginning in 1916
4. Seed borne diseases beginning in 1918
5. Longevity of seeds beginning in 1919
6. Identification of sweet clovers beginning in 1919
7. Determination of origin of seeds beginning in 1919
8. Correlating laboratory tests and field germination beginning in 1920
9. Impermeable seeds beginning in 1920
10. Light, KNO_3 and soil in germination beginning in 1922
11. Commercial analysts' organization suggested in 1922
12. Sorghum-sudan hybrids beginning in 1924
13. Mathematics of seed testing beginning in 1924.

Numerous lines of investigation have been carried on all of which have a bearing upon the chief problems with which we have been concerned.

PUBLICATIONS.—1. Proceedings from 1908 on. This has proved to be an extremely valuable reference work, a publication of which our association may well be proud. The work of editing it has fallen to the lot of our current Secretary-Treasurer.

2. The *News Letter* was begun in 1927 and has been fortunate enough to have been carried through its entire life history by two editors.

3. The association has been fortunate to have the Rules and Regulations which it has adopted printed twice under other auspices, thus entailing no cost to our organization.

A list of officers and meeting places is appended.

We have elected 21 members to the office of President in 28 years. In the same period the important and heavy work of Secretary-Treasurer has been carried by six men.

A circular which was sent out in April to all laboratories has not yet had a unanimous response but has brought an accumulation of valuable, interesting, and characteristic data on seed testing in various states—under various auspices.

It has been suggested by three laboratories that it would be interesting to have the history of seed work in one state published in each issue of the *News Letter*.

Meetings and Officers

Annual meeting	Date	Place	Date Proc. Pub.	Officers		
				President	Vice-president	Secretary-treasurer
1	Dec., 1908	Washington, D. C.	1915	E. H. Jenkins		Edgar Brown
2	Dec., 1909	Boston, Mass.	1915	E. H. Jenkins		Edgar Brown
3	Nov. 1910	Washington, D. C.	1915	E. H. Jenkins	H. L. Pammel	Edgar Brown
4	Nov. 1911	Columbus, O.	1915	E. H. Jenkins	H. L. Pammel	Edgar Brown
5	Jan. 1912	Cleveland, O.	1915	G. I. Christie	C. P. Smith	Edgar Brown
6	Nov. 1913	Washington, D. C.	1915	G. P. Burns	W. L. Oswald	Edgar Brown
7	Nov. 1914	Washington, D. C.	1915	W. L. Oswald	E. D. Eddy	J. P. Helyar
8	Dec. 1915	Columbus, Ohio	1916	W. L. Oswald	E. D. Eddy	J. P. Helyar
9	July 1916	Minneapolis, Minn.	1917	E. D. Eddy	A. L. Stone	J. P. Helyar
10	June 1917	Detroit, Mich.	1917	A. L. Stone	G. T. French	J. P. Helyar
11	Jan. 1919	Baltimore, Md.	1919	G. T. French	H. D. Hughes	W. L. Oswald
	1918					R. C. Dahlberg
12	Dec. 1919	St. Louis, Mo.	1921	H. D. Hughes	Edgar Brown	R. C. Dahlberg
13	Dec. 1920	Chicago, Ill.	1921	Edgar Brown	J. P. Helyar	A. L. Stone
14	Dec. 1921	Toronto, Canada	1923	Geo. H. Clark	Jessie Fiske	A. L. Stone
15	June 1922	Chicago	1923	E. W. Taylor	A. K. Peitersen	A. L. Stone
16	Dec. 1923	Cincinnati, O.	1924	F. W. Taylor	A. K. Peitersen	A. L. Stone
17	Dec. 1924	Washington, D. C.	1925	M. T. Munn	W. H. Wright	A. L. Stone
18	Dec. 1925	Kansas City	1926	Anna M. Lute	W. H. Wright	A. L. Stone
19	Aug. 1926	Ithaca, N. Y.	1928	W. H. Wright	Eliz. Hopkins	A. L. Stone
20	June 1927	Detroit, Mich.	1928	W. H. Wright	E. H. Toole	A. L. Stone
21	Dec. 1928	New York City	1929	E. H. Toole	Bess Crowley	A. L. Stone
22	Dec. 1929	Des Moines, Ia.	1935	F. S. Holmes	G. T. French	A. L. Stone
23	Dec. 1930	Cleveland, O.	....	A. L. Stone	C. W. Leggatt	F. S. Holmes
24	Aug. 1931	Toronto, Canada	....	C. W. Leggatt	F. H. Hillman	F. S. Holmes
25	Aug. 1932	Fargo, N. D.	....	F. H. Hillman	O. A. Stevens	F. S. Holmes
26	June 1933	Chicago, Ill.	....	O. A. Stevens	W. L. Goss	F. S. Holmes
27	June 1935	Minneapolis, Minn.	1936	W. L. Goss	W.O.Whitcomb	F. S. Holmes
28	June 1936	Rochester, N. Y.	1936	W. O. Whitcomb	G. A. Elliott	F. S. Holmes

REPORT OF THE EDITOR OF THE *NEWS LETTER*

M. T. MUNN

Agricultural Experiment Station, Geneva, N. Y.

A report as editor of the *News Letter* can be very brief since members and readers are undoubtedly thoroughly familiar with its make-up and contents. What has been said previously regarding lack of support expected from readers may well be repeated. This publication, due to the lack of material, is by no means rendering the great service it could. The lack of material is not because of its scarcity but because of the failure of members everywhere to collect, prepare, and send such to a central place or to the editor to be collected, copied and distributed to all others. As examples of types of material needed, conditions of seed crops in the producing areas which influence purity or viability, the appearance of new weed impurities, new methods of practice, changes in policy, administration or in laws, newly developed laboratory equipment, changes in personnel, personal items, these and many more are the things which workers desire yet we are all too busy, too modest, or too indifferent to carry out the original intent of the Analysts' *News Letter*.

Reference to the original intent of the *News Letter* leads me to perhaps the most important point or possibly change of policy which has occurred during the year. Due to dearth of newsy material the editor turned to excellent technical articles not published elsewhere for really filler to satisfy the popular demand that the *News Letter* should appear regularly. This at once brought about a demand from wide and varied sources for exchange of publications, extra copies and subscription all of which bring a multiplicity of detail work or attention. The *News Letter* then changed from such to a publication and was cited and placed on file in libraries interested in agricultural subjects. It was apparent that such a policy must be quickly changed or else adequate provision made for carrying on such an enlarged program. This would really bring the *News Letter* from a newsy, informal, house organ of the Association into the realm of a "Proceedings" of the Association. Briefly then it would seem that it is for the Association to decide what policy is to be followed and what provision is to be made for continuance. It can become a more or less confidential publication to members only, or extend to a larger group of professional analysts and laboratories everywhere, or indeed become a full fledged publication.

Financially speaking the conditions are about the same as during the previous year. An effort has been made to keep its maintenance within the limits imposed. The editor was not at all satisfied with the mechanical make up of some of the issues but they were the best possible under the circumstances. Sincere thanks are due those who have cheerfully contributed written material and thus have made past issues possible.

PRESIDENTIAL ADDRESS

THE OTHER FELLOW'S VIEWPOINT

W. O. WHITCOMB

Agricultural Experiment Station, Bozeman, Mont.

"There is nothing new under the sun" is an old saying which is often found to be very true. President Roosevelt expressed this thought not long ago in an address upon the occasion of receiving an honorary degree from Rollins College, in these words: "We adhere to steadfastness of old ideals; all we change is our method of approach." A review of the ideals and activities of the Association of Official Seed Analysts of North America, as recorded in the Proceedings of the meetings covering the past 27 years, reveals the fact that many of the thoughts and many of the problems which demanded the attention and occupied the time of our members in former years are still our ideals and our concern today.

Policies and Problems of the Past

"Non-uniformity in seed testing methods" was stressed in the eighth annual meeting in 1915. In 1916 it was observed that "the most valuable results so far attained are not so much in the discovery of new principles and methods as in finding out our deficiencies and setting about to remedy them." In the same year seed legislation was discussed by a member of the association and a uniform state seed law was advocated by a member of the seed trade, who was present. Again, the viewpoint of the seed trade people and their interest in our work was shown in a paper entitled "Seed Laws and Seed Testing from the Viewpoint of Seedsmen" which was presented by a prominent seedsman at our eleventh annual meeting in 1919. In this paper he stressed the value of conferences between seedsmen and seed analysts from the official laboratories in the development of new ideas and ideals and cited the Uniform Seed Law as a good example of cooperation. At the 14th annual meeting the president discussed the scope of the work of the association and concluded with the thought that we should aim to devise the best and most practical system by which farmers may recognize within certain limits relative quality in the seeds which they purchsae.

In 1922 the president of the Association of Commercial Seed Analysts of North America presented the viewpoint of his association in a paper entitled "The Problems of a Commercial Seed Analyst". In this paper it was shown that the concern of the Commercial analyst is not so much with the actual work performed as with the purpose which the results have to serve. A plea was made for coordinating and rearranging the laws of the various states and to establish uniformity.

At our meeting in June, 1923, President Taylor in reviewing 75 years of agricultural progress on the 75th anniversary of the founding of the American Association for the Advancement of Science, traced the beginnings of seed testing and listed among the objectives which this association should have, the training of expert and competent analysts, the conducting of investigational work which may serve as a basis for standardizing of methods and

placing the art of seed testing on a more uniform basis and on a higher scientific plane, and lastly, to aid in the enactment of legislation which will measurably control the quality of seed placed upon our markets.

"The formulation of a policy founded upon a practical and fundamental basis" was cited as the greatest problem before the seed analysts by our president at the 17th annual meeting. In this he stressed the obligations of the seed analyst, the seed dealer and the seed buyer. At our last meeting some developments in seed testing were sketched and some problems in law enforcement were discussed.

OUR PRESENT CONCERN

With this as a background, I wish to think through with you some of the policies and problems that are confronting our association and seed analysts in general at the present time. In doing this, let us consider our relationships with the people with whom we come in contact and the influence which our activities as seed analysts may have on others.

In that once popular book "Ships That Pass in the Night" occurs this passage: "We do not belong to ourselves; there are countless people depending on us, people whom we have never seen and whom we never shall see. What we do decides what they will be." This is an arresting thought. Everyone can recall a case where, if someone had acted differently, the whole subsequent stream of life would have been different. In short, let us give some consideration to the other fellow's viewpoint.

We, as seed analysts and as members of this association, come in contact with people who are interested in seeds from many angles. The producer, the jobber, the retailer, and the consumer, all command our attention. Each of these looks at seed from a somewhat different standpoint. Each is influenced by his knowledge of seeds in general and by the volume of business which he is doing. Some have years of experience back of them and have a full knowledge of seeds, while others are just starting in business and know but little of the kinds and uses of seeds. Then too, we have the large number of retailers with whom seeds are a sideline.

The seed analyst is confronted with the problem of rendering service to the people in these different groups in a way which they can thoroughly understand and yet be perfectly fair with the other people. In doing this, one must learn enough about the business of the person with whom one is dealing to appreciate his viewpoint and impart to him enough of the methods employed in seed testing to enable him to understand the results which are obtained by the seed analyst. It is apparent that the attainment of this aim will require time and patience on the part of all concerned.

First, let us consider some of the problems that confront these four classes of seed dealers and see how the official seed analyst may fit into the picture. In doing this we must think of the analyst as one who thinks of seeds from the standpoint of what they are and their quality and not of seeds as a crop or a product to market, as a commercial commodity to merchandise, or as seed to be selected for planting to produce a crop under certain conditions. Yet the analyst, because of his duties and his contact, has a certain point of vantage not occupied by many others.

The seed producer may specialize in one or two kinds of seeds or he may grow some of several different kinds. These may be marketed through jobbers, sold direct to retailers, or distributed directly to the consumer. It is fair to assume that in each of these modes of marketing the seed producer looks

upon his product in a somewhat different way. The point with which we as seed analysts are most concerned is the knowledge which he has as to the quality of this seed. This has to do with trueness to variety, mixtures, weed seed content and viability. Adaptability of varieties is also of importance. It is very apparent that, provided with this knowledge of his product, the the seed producer could sell his seed to a much better advantage than many of them do at the present time.

It then becomes his task to acquaint himself with such of these points as he is not already familiar. In doing this he is not only enabled to make plans for the production of a better product, but he can secure a better price for it and he is enabled to properly label it so as to comply with the law. It should be the policy of the seed analyst to so equip himself and his laboratory as to supply this information to the producer in the most effective manner when so requested.

The jobbers' problems, while very different from those of the producer, are equally numerous. The buying of seed from producers, grading, recleaning and processing it so that it can be delivered to the retailer in attractive packages at the proper time, entails a knowledge of seed and an investment of capital that but comparatively few people appreciate. His field buyer is constantly confronted with the problem of quality in relation to price and probable demand for different kinds and grades of seed. Those buyers who have a well trained commercial analyst in their employ are fortunate, but those who are not so equipped are required to buy on an estimate of the quality by appearance or call upon commercial laboratories or official laboratories for service.

When the seed is in the jobbers' warehouse, the work of cleaning, grading and blending begins. It is then that the services of the commercial analyst become most valuable as referred to back in 1922 when the president of the Association of Commercial Seed Analysts told members of our association that the principal concern of the commercial analyst is the purposes which the results of his work have to serve. It is at this point that there should be agreement in analytical work between the commercial analysts and the official analysts into whose hands the seed may fall. If there is not agreement here there is bound to be disagreement when the seed is labeled and placed in the hands of the retailer for sale and the inspector samples the seed and it is tested and the results compared with the label. Or, if the seed is sold under certain specifications and delivered to various states it is highly desirable that the commercial analysts' results in the jobbers' blending plant and the inspection results in the official laboratories in these states agree.

SOME CONCRETE CASES

This raises a question which has received some attention in commercial seed circles the past few months. I refer to the statement which was made relative to the lack of uniformity in purity and germination tests made in official laboratories of different states and that Federal prosecution was made in some instances and fines assessed which were unwarranted on the basis of correct analysis. One instance of this inaccuracy was substantiated by the statement that one laboratory had condemned a shipment of seed because it contained quackgrass and another laboratory found it to contain nothing but harmless wild barley. It is certainly a most lamentable condition that these things occurred, but it is equally lamentable that certain errors have occurred on the part of analysts employed by some seed houses. Allow me to

cite one case which came to my attention in 1934. A small shipment of white clover was received by a retailer in Montana from a large jobber in another state and placed on sale bearing the analysis tags of the jobber. When this seed was sampled by the Montana inspector and was analyzed it was found to contain 4.8% total weed seeds as compared with 0.65% reported by the jobber. When the report was made to the jobber, as is customary, he asked for a recheck of the analysis for weed seeds. This was done and the results found to be correct and that most of the weed seeds were black medick, sometimes called yellow trefoil. However, it was not until the presence of this black medick had been confirmed by three other official laboratories that the final report was made to the jobber. No further reply was received from him. I have cited these two instances merely to show both sides of the case.

In the August, 1934, issue of *Seed World* appeared an article, entitled "Jobber's Responsibility to Dealer" by W. R. Schoenfeld. This is a well written article in which the author shows that the jobber must serve the retail dealer by (a) maintaining sufficient stocks for restocking the dealer's depleted supplies, (b) render prompt service, (c) giving reliable information on prices, etc. through his salesmen, (d) not selling to price cutters, (e) not overstocking dealers, and several other very essential points. All of this service for the retailer is very helpful, but it seems that there is one important point which has been overlooked. The point to which I refer is the labeling of the seed so that the dealer can readily comply with the law in the state in which the seed is retailed. A more general study of the state laws by the jobbers and a more careful labeling of the seed before delivery would do much to help the dealer and aid very materially in the law enforcement work by the state officials.

As previously noted, many of the retail dealers carry seeds as a sideline and know comparatively little as to the quality of the seeds. It would seem that in the interest of good seed and supplying the consumer with the proper information as to his seed, the dealer should receive aid not only from the jobber but from the seed inspector and the official laboratories as well.

The consumer can do much in the development of this program of cooperation and seed improvement by familiarizing himself with seed quality and buying only that seed which is properly labeled. Since much that has been said in this paper applies eventually to the quality of seed which is supplied to the consumer, his interests in the matter must not be overlooked.

THE PROBLEM SUMMARIZED

A comparison of our present problems and policies with those previously mentioned as having been gleaned from the proceedings of our meetings for the past 27 years, indicates that they are much the same. Lack of uniformity in seed testing methods, finding out our deficiencies and remedying them, uniform state laws, devising the best and most practical system by which farmers may recognize quality in seed, training of competent analysts, investigational work as a basis for standardization of methods, and the formulating of a policy founded upon a practical and fundamental basis, are all problems which are still with us. An added problem, or rather a new approach to some of our old ones, is to study the problems and methods of doing business of those with whom we deal, in order that we may be the better able to appreciate their viewpoints. We should also present to them our policies and methods in such a way that they can understand our methods of doing things and what we are attempting to accomplish.

THE REMEDY

If we recognize that some of our problems have to do with the problems of those with whom we deal, we recognize a partial solution, at least. In this discusssion I have taken the stand that we as an association and as individuals should study more closely the problems of the commercial seed interests.

I wish now to raise the question as to how far we can go in this matter. Some analysts have expressed themselves as favoring the limiting of their work to the testing of samples of seeds which have been drawn by the inspector and leaving the testing of seed for other purposes to commercial analysts. I hardly favor this.

The renewed interest in our work which has been shown by the members of the seed trade association is encouraging. The suggestion by the chairman of the Farm Seed Group of the American Seed Trade Association that there be a member of our association on their committee indicates that they wish to cooperate with us. The recent invitation of this same group for a representative of our association to appear on their program on June 29 in Dallas is further evidence of their desire to cooperate with us.

Now, the question arises as to what we can do in our association to meet this criticism of lack of uniformity of results of which we have recently been hearing. It would seem that our activities might well be grouped under the following heads:

1.—Better standardization of our rules for seed testing. This is being well cared for by our present committee on rules.

2.—Completion of the handbook on seed testing as an aid to analysts. This has been a long task, but progress is being made.

3.—Formation of a more stable form of our Research and Methods Committee. This is already being provided by a plan to be submitted by the present chairman of our Research Committee.

4.—A more active system of referee testing.

5.—A greater use of the courtesy of other laboratories in the confirming of the results of certain tests which have been questioned.

6.—The use of the referee committee as a source of information when certain analysts wish to have seeds identified or to secure other information.

7.—A freer and more frequent exchange of ideas and results with other official laboratories in regions where seeds move in interstate shipments between those regions.

8.—A freer exchange of ideas and a better understanding of methods of sampling and testing by the official analysts with the commercial analysts who work on seeds which enter the markets of the various states.

9.—Compilation of the seed laws of the various states by our association for ready reference. This has already received some consideration.

10.—The completion of the publication of our PROCEEDINGS and the indexing of the entire PROCEEDINGS for ready reference.

A MESSAGE TO THE

ASSOCIATION OF OFFICIAL SEED ANALYSTS OF NORTH AMERICA

FROM

THE AMERICAN SEED TRADE ASSOCIATION FARM SEED GROUP

EARL M. PAGE, President
CORNELI SEED COMPANY
St. Louis, Mo.

The purpose of my appearance before you today is to express to you, on behalf of the American Seed Trade Association, a sincere desire for a closer relationship and more complete co-operation between our two associations, and to offer concrete suggestions for constructive co-operative effort. The possible benefits from such united endeavor are manifold and would, we believe, accrue to the mutual benefit of the seedsmen, the analysts, and to the consumers alike.

There are many splendid examples of very close co-operation indeed between individual seedsmen and individual analysts or laboratories in working out local problems, but the criticism has been offered, and not without justification, that the American Seed Trade Association, as such, has not attempted actively to co-operate with the Association of Official Seed Analysts of North America in solving the problems which concern all of us vitally.

Recognizing this need, a committee was appointed by the Farm Seed Group of the American Seed Trade Association at its January meeting to study the matter and make recommendations at the annual meeting of the Association, which will be held in Dallas the last of this month. Mr. H. Trimble McCullough is chairman of this committee.

Since the convention of your Association precedes that of the American Seed Trade Association, the committee has asked me to offer its recommendations, of course subject to final approval of the American Seed Trade Association in its annual convention.

I am also asked to extend to your Association an invitation for some member of your group to address the Farm Seed Group Meeting of the American Seed Trade Association in response to these proposals, expenses of the trip to be borne by the Farm Seed Group. We also extend a welcome and hearty invitation to all members of your group who find it possible to attend the meetings of the American Seed Trade Association in Dallas.

You have probably guessed, and rightly so, that a matter of great concern to seedsmen, as well as to analysts, is the variation in purity and germination tests as made in any two or more laboratories. The very nature of the commodity unquestionably accounts for some variation and makes impossible the exact analyses obtainable in analytical work with inert materials and inorganic chemicals.

When we stop to think that seeds are living organisms carrying on the respiratory processes of life and discharging the waste materials resultant therefrom, and that the seed, while in a comparative state of rest, is capable of full and complete development into a living plant, similar to its parent, but always with its own individual characteristics, no two of them, either seeds or the plants, exactly alike, it is little wonder that we have difficulty in attempting to judge by artificial or semi-artificial means the exact percentage of seeds which are capable of this full and complete development. Likewise, with the millions of genera, species, varieties, and strains of varieties in vegetable life capable of reproduction by seed, is it little wonder that our nomenclature may be at times faulty in the classification of weeds, so that a comparatively harmless weed may erroneously be classified as one of its more noxious cousins or vice versa.

It is unnecessary here to recite specific instances of these variations in tests. We have in our files records of a number of instances of such variations, and we presume most seedsmen have similar cases. Referee tests made under the auspices of your Association are undoubtedly doing much to minimize these variations. At the same time, the very fact that you do conduct such referee tests indicates that your Association recognizes the existence of important variations. Most seedsmen, that is, the executives of seed firms, are not seed analysts. Many of them have had training in seed analysis, but, in general, their viewpoint is somewhat empirical. The leading seed firms, however, have in their employ analysts devoting their entire time to analytical work. Many of these analysts, as is the case with the analyst of our firm, have studied in the Government Laboratory at Washington, or in other official laboratories. I can say without hesitation that the vast majority of these private seed analysts are conscientious in their work and maintain a certain professional or scientific indifference toward the result of a test or its commercial significance. In our own laboratory, tests are made by number so that at the time of the test the analyst does not know the source of the particular lot under test. We believe this is the general practice.

We are also convinced of the sincerity and integrity of both the official and commercial seed analysts. It was my privilege to be in horticultural work with the Missouri College of Agriculture for a period of six and one-half years, during which time, I had the opportunity of contacting a number of analysts personally, and I was impressed then, as I am now, with the patience and conscientiousness with which their work was carried out.

One question has been raised which may be worthy of note. This is the practice of using undergraduate student help in the making of official tests. We have heard of instances wherein this plan is followed but have no idea of the extent of the practice. So much is involved in the accuracy of these tests that you will readily agree with us that only the most highly trained personnel should be permitted to pass the final judgment implied by an official test.

Were variations existent only between tests made by the seedsmen's private analysts and the official analysts, then we might readily assume that the trouble lay wholly with the seed trade. But this is not the case. Almost every seedsman sends some samples out for test, either by commercial laboratories or by official analysts. Our own observation is that tests vary as greatly between two or more official seed laboratories as they do between our tests and any one official laboratory.

In order to clarify the position of the legitimate seed trade toward the regulatory functions of official analysts, I should like to say a word on this

subject. We consider reasonable and practical seed laws, and their intelligent enforcement, necessary to the maintenance of high standards in the seed trade. In addition to the protection afforded to the consumer, they offer a very definite protection to the conscientious seedsman.

The seed trade has invested large sums of money in cleaning equipment for the removal of weed seeds and inert matter. It has invested large sums of money, and entails a continuous and important expense, in the maintenance of laboratories. Without regulation, these investments are largely of no avail to the seedsmen, and the consumer is deprived of the benefits of better quality and greater freedom from weeds which they make possible.

In recent years, the fly-by-night truck peddler of seeds has caused us considerable worry, and, although they are noted for such practices as selling screenings from lespedeza, alfalfa, and other seeds, as country run seed to the unsuspecting consumer or country dealer, selling sweet clover as alfalfa when they can get away with it, they have still done a tremendous volume of business, with detriment to all concerned except themselves. We therefore welcome the proper enforcement of seed laws, but, at the same time, we must have uniform methods of making tests so that the tests made in seedsmen's laboratories, or in commercial laboratories, will check with the official tests from samples drawn in the field. In the exercise of your regulatory or police functions, we should like for you to bear in mind that it is just as desirable for you to protect and encourage the conscientious seedsmen as it is to protect the consumer.

1. In consideration of these facts, the committee has authorized me to suggest to your Association, subject, of course, to the final approval of the American Seed Trade Association late this month that a sum of money be placed annually at the disposal of your Research Committee co-operating with our committee on this subject to carry on their studies as to the causes of variations in both germination and purity tests, and with a view to standardizing procedure and the interpretation of tests to secure greater uniformity. The problem is one well understood by your Research Committee, and the line of attack can no doubt be best determined by your committee. Our committee preferred this plan to another plan which I will mention because we felt that the fund of knowledge and experience possessed by members of your Research Committee would eliminate lost motion and lost time. It would undoubtedly bring about some of the desired results at an earlier date than would the alternate plan. We have estimated that from $250.00 to $500.00 per year might be required to defray expenses of your committee in this work, and if this plan is preferred, that such an amount should be appropriated by the American Seed Trade Association. If our estimate of the amount necessary for expenses is reasonably accurate, it should be possible for the seed trade to continue this appropriation over a period of years with increasing benefit to all parties interested in seed analysis. Our only hesitancy in suggesting this plan is the added burden it will place on your Research Committee, for we realize that the time of all members is well occupied with their regular duties.

1a. The alternative to the above plan comes as a suggestion of a group of about twenty seedsmen, members of the American Seed Trade Association. Our committee appointed to study the problem prefers the plan already outlined, but thinks it worth while mentioning the following alternative plan for your consideration and, of course, either proposal is contingent on final approval of the American Seed Trade Association. This altenate plan con-

templates the establishment by the seed trade of a two year graduate research fellowship, leading to the Doctor's degree with one of the outstanding state agricultural colleges where an official seed laboratory is maintained. An appropriation by the American Seed Trade Association to cover this work has been suggested as follows:

$1,000 per year as a stipend to the student.

$250 per year to cover incidental expenses, such as the purchase of supplies and the cost of necessary travel.

The practical purpose of this fellowship, in general, would be to study the present methods of seed analysis and to determine, if possible, the causes of these wide and annoying variations. It would be hoped that as a result of these studies the present rules for seed testing might be so modified and standardized as to result in a practical degree of uniformity.

We suggest that the scope of the student's studies on germination tests include such subjects as sanitation, media, temperature, duration, the effect of light, abrasion of seed coats, and possibly the artificial introduction of various salts to simulate the general characteristics of the average soil solution. At the option of the governing committees, later to be defined, there might also be considered the effect of time, temperature, and other storage conditions on germination, as it is the belief of seedsmen that many of the difficulties arise due to influences affecting the seeds after shipment.

We suggest also that the student consider the matter of purity tests, particularly as to methods now employed in drawing samples both by seedsmen and by inspectors in the field, and, further, that he study present methods used in the determination of purity with a view, if possible, to standardizing this procedure and minimizing variation between tests of the same sample.

Again, at the option of the governing committees and time permitting, we suggest that the student endeavor to standardize for practical purposes the nomenclature of weeds. Scientific names seem well standardized, but great confusion has existed in attempting to translate these to common names. Some work has already been done in this direction and we believe it would be relatively simple to co-ordinate this work and standardize common names.

If this plan is approved by the Association of Official Seed Analysts of North America, the seed trade desires that your Association recommend to the American Seed Trade Association the institution with which the fellowship should be placed. In this connection, we ask that two or more institutions be recommended in the order of your preference.

Since some detail will be involved in the selection of candidates and in the work of selecting and contacting the proper agricultural college, we consider it advisable that an existing committee of your Association be designated, or a new committee be appointed, to co-operate with a similar committee of the American Seed Trade Association in carrying out this program. Your committee may be instructed at this convention as to the institutions to recommend, or this may be left for the discretion of the committee.

We also ask that your Association nominate candidates for this fellowship. Probably this can best be done through your committee, with each member of the Association privileged to suggest names and list qualifications of candidates known to him.

Qualifications for the fellowship should include a Bachelor's degree in Agriculture and the degree of Master of Science or Master of Arts, with a thesis on some scientific subject, preferably relating to agriculture, botany, phytopathology, plant physiology, or chemistry.

After examination by your committee of qualifications of candidates whose names come before them, we ask that your committee select several whom they consider qualified to carry on this work to a successful conclusion, and that these names, together with the qualifications as known, be then presented to a committee on the American Seed Trade Association for its approval and recommendation to the selected agricultural college. Final selection of the student to be awarded this fellowship must necessarily rest with the graduate committee of the college selected.

It is hoped that the supervising professor of the college selected will permit and welcome the counsel of the joint committee of the two sponsoring associations in planning and carrying out the research program outlined. It is also hoped, and may even be expected, that the joint committee will be able to prevail upon the institution with which this fellowship is placed to waive matriculation and laboratory fees and to place at the disposal of the student the necessary equipment for carrying on the work.

The student shall be free to publish his findings in scientific journals and in pamphlet form, as he may desire. These findings shall also be available to the American Seed Trade Association for reprinting in whole or part, as it may see fit, and to the Association of Official Seed Analysts of North America for distribution to its members.

2. Another suggestion which we have to offer is that your program of making periodical referee tests be enlarged and extended to include the private laboratories of seedsmen. We believe that such a plan will go far toward co-ordinating the methods and procedure in all laboratories, particularly if your Research Committee, through your Sub-Committee on Referee Tests, can see its way clear to send out at least twelve or fifteen samples each year, and tabulate the results, preferably with the name or keyed number of each laboratory appearing opposite each test, arranged in three groups: that this, official laboratories, commercial laboratories, and private laboratories. This, with a general symposium or critique by your committee, will serve to standardize the methods of dealing with the problems illustrated by these samples.

No doubt there will be some expense in connection with sending out these samples and in publishing the results, and we might suggest that to defray these expenses, an associate membership be established in your Association for private laboratories of seedsmen, with dues sufficient to cover their pro rata share of this expense. The names of seedsmen interested in co-operating in this work would be supplied by the Laboratory Committee of the American Seed Trade Association.

3. Our third suggestion for closer co-operation is that private laboratories of seedsmen be given an opportunity to subscribe to your news letter and to your handbook, which, we understand, is now in course of preparation.

4. The fourth proposal which we wish to make, or perhaps it may be more appropriately termed an invitation, is that the Association of Official Seed Analysts of North America hold its annual convention at the same place and approximately the same time as the annual convention of the American Seed Trade Association. Since we are both concerned with the same problems, we believe that this would be a very logical and beneficial arrangement. As you probably know, we normally have some expression from the membership in the annual convention as to the place of the next annual meeting, but the exact date and place are selected by the Executive Committee of the American Seed Trade Association at its January meeting. Undoubtedly you have a

similar committee authorized to make definite plans for your meeting, and by conference between the committees I am sure that mutually agreeable dates and cities could be selected.

We earnestly ask that you give consideration to these proposals, and, if there is any message you wish me to carry back to our Association, I shall be glad to do so. It would be far more desirable, however, if a member of your Association could be present with us in Dallas, and give us your response.

SHOULD OUR ASSOCIATION BE INTERESTED IN THE TWO PURITY ANALYSIS METHODS OF THE INTERNATIONAL SEED TESTING RULES?

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Just at this time when our association is deeply concerned with changes in our Rules for Seed Testing and the fundamental principles underlying them it seems appropriate to again consider the very important question of the two methods of arriving at a percentage of pure seed as provided for in the International Seed Testing Rules. To those of use who have to do with stocks of imported seeds and their accompanying descriptions particularly in the form of germination percentages this matter is of especial importance. From the very first our association, because of previous experience, has been vitally interested in the formulation of rules which all could follow and has opposed the adoption or inclusion of the so-called Stronger Method (S.M.) as it now appears in the testing rules (I. S. T. R.) of the International Seed Testing Association. This so-called Stronger Method of purity analysis is a curious combination of an attempt to combine a purely physical determination having to do entirely with mass, weight, or volume, with a purely biological determination based upon percentages of individual units. There are a few European laboratories where workers claim they are able to follow this method consistently, also, some claim that all European seed testing stations follow that method. Study and investigation, however, show plainly that not all European stations follow that method or are in favor of it. A study of the analysis results of the referee samples does not yield very much information since one cannot discover who used the method or to what extent they were capable of exercising the kind or degree of judgment which the method allows. It is plainly evident to anyone who will take time to investigate the matter that the illustrations and descriptions given in the Rules are of little value. To use them is to attempt the unique combination of trying to make a premature germination test in the analysis room. For instance many seeds set aside as "pure seed" because of a minimum of mechanical injury produce broken sprouts while on the other hand seeds badly damaged and classed as "inert material" under the Rule produce normal seedlings. These and other considerations such as, length of time necessary, uncertainty of method of application or degree of judgement possible, have previously lead our association and students of seed testing to oppose the use of this method. The great danger or really serious objection to the so-called Stronger Method comes when a germination test percentage obtained by some uncertain degree of application of this method is quoted alone. Both mechanical purity and

viability test should be capable of being repeated by a certain definite or standard method by competent workers everywhere. We believe there should be but one method of purity analysis or determination and that one should be as close as possible to physical purity and capable of being applied consistently by all competent analysts.

Repeated requests directed to the officials and proper committees of the International Association for a consideration or study of this question looking forward to a solution through the adoption of but one rule along the lines of our American rules have either been ignored, placed on file, or failed because of other reasons. The question is of such importance that the writer again proposes that the association address formal resolutions to the president of the International Seed Testing Association and to the chairman of the Research committee under which the formulation of the present Rules took place for their consideration.

Resolution on adoption of one purity analysis method in International Seed Testing Rules.—It has become evident from a comparison of referee tests and further study and investigation into the matter that the so-called Stronger Method (S.M.) of arriving at a pure seed percentage being founded upon incorrect principles is not entirely practical and cannot be followed with consistency and safety by technical workers everywhere. That its use has led to confusion and difficulty because high germination percentages secured following its use are quoted alone and without reference as to how or by what method they were obtained.

It is the sense of this meeting that this Association again call to the attention of the International Seed Testing Association the great desirability of having in the International Seed Testing Rules but one method for making a pure seed determination and that method be as close as possible to a physical purity as is exemplified in the so-called Shorter Method (Q.M.) now in the Rules. That all attempts to consider viability when making a purity analysis be eliminated. To this end this resolution is respectfully submitted to the President, the Executive Committee and the Research Committee of the International Association urging their careful and full consideration of this important matter.

"NON-WARRANTY" OR DISCLAIMER CLAUSE

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A study of the "Non-Warranty" or Disclaimer clause, as used by commercial seedsmen, has been made and the results of this study are presented herewith.

The study was conducted by sending out questionnaires to the different state officials and persons of commercial interests. An effort has been made to pool the information contained in these different letters.

History of "Non-Warranty Clause"*

"The disclaimer of warranty clause, hereafter called the 'disclaimer clause', came into existence as a result of an informal meeting of some seedsmen who were dismayed by a recent decision of a New York court that the vendor of seeds became an implied warrantor of the description or quality of the seeds under the court's interpretation of the common law principles in a sale or contract of sale of personal property. Mr. Bruggerhof, who attended that meeting, was many years ago Mr. Smith's informant that the seedsmen submitted their problem to Mr. Choate, the leader of the New York Bar, who wrote on an envelope a disclaimer of warranty and returned it to the waiting seedsman with his bill for $100. This disclaimer was adopted by the seedsmen and is the same one at present, except as it was modified at the annual convention of the American Seed Trade Association in June, 1914, when Mr. Smith, because of a change of methods in merchandising seeds, found it necessary to eliminate one phrase of the original disclaimer clause. Consequently the disclaimer clause formally adopted by the American Seed Trade Association in 1914 and by the Wholesale Grass Seed Dealer's Association in June, 1921, and reaffirmed by the A. S. T. A. in June 1924, reads:

"'The ————————Company gives no warranty, express or implied, as to description, quality productiveness or any other matter of any seeds, bulbs, or plants it sells and will not be responsible for the crop.'

"Up to 1909, the disclaimer clause was not very seriously considered by the seedsmen in its true legal aspects, although in those years the disclaimer was found in most of the catalogues of seedsmen, sometimes very inconspicuously displayed. In Counsel's study of the seed problems it became all too evident that the seedsmen, in the sale of a natural product, oftentimes indistinguishable in its appearance from many other kinds of varieties of seeds, was assuming a contractual responsibility which he is not justified in assuming, especially in regard to damages which might be assessed for loss or deterioration of seed. Already had been noted verdicts of several thousand dollars for the sale of seed that had cost only four or five dollars, the profit of which, of course, could only be estimated as a small part of the purchase price of the seed. It was recognized that seed as a salable commodity was

*The history of the "Disclaimer-Clause" was made possible through the courtesy of Mr. Curtis Nye Smith, Counsel American Seed Trade Association, who was kind enough to submit the following history.

entirely different from a manufactured article, the component parts of which could be definitely analyzed, and determined. Mr. Smith felt that the disclaimer of these responsibilities for crops or for seed indistinguishable by their appearance could not be assailed in the courts of law as contrary to public policy. Counsel was equally satisfied that any statute which attempted to deprive the seedsman of his right to protect himself by this disclaimer of warranty would be held unconstitutional as an unreasonable exercise of the police power. After 1909, therefore, there followed a definite program by the A. S. T. A. to advise seedsmen of the necessity for the widespread or general use of the disclaimer of warranty clause in every way which would attach that clause to a sale or contract of sale of seeds. The public was equally and as fully advised of the necessity of such disclaimer clause."

"There being no decisions of the courts in this country which could be authoritatively quoted in favor of this disclaimer clause, Mr. Smith, as Counsel of the A. S. T. A., instituted or caused to be instituted suits in many of the courts of the states, in which the issue was the validity of the disclaimer clause; such cases being carried to the Supreme Courts of the states, have, without exception, sustained the validity of the disclaimer clause in these cases where it had been brought within the terms of the sale or contract of sale. Inasmuch as the disclaimer clause has been so universally used by the seedsmen in this country, there arose a principle of law, to wit: The general custom of the trade in the use of this disclaimer, which attached itself to the contract of sale, even though the clause has not been expressly mentioned in the contract of sale; such favorable decision was primarily secured in the case of Miller Vs. Germain Seed Co., decided by the Supreme Court in California, and has been followed in several states since then, although in some states it must be added, this general custom of the trade is not accepted and it is necessary in such states to have the disclaimer clause inserted in the sale or contract of sale."

"Perhaps it is of interest in this historical treatment of the disclaimer clause to mention that the most recent and outstanding judicial determination of the validity of the disclaimer clause was written by Justice Cardozo, now a member of the Supreme Court of the United States, but at that time the Chief Justice of the Court of Appeals of New York State, the highest court in that state, the case being entitled Lumbrazo vs. Woodruff (12). In the Trial Court, which in New York State is called the Supreme Court, and in the Appellate Division of the same court, this case was unanimously decided in favor of the purchaser of seeds and against the disclaimer of warranty. However, in the Court of Appeals there was a unanimous decision of the Justices reversing the judgment of the lower court and completely sustaining the disclaimer clause in every particular. In view of the searching examination of this case by Justice Cardozo, it will be extremely difficult for opponents of the disclaimer clause to have much support in any court."

PROTECTION OF DISCLAIMER TO SEED DEALERS

It is hard to evaluate the protection that the disclaimer affords the seed dealers. It is generally conceded that it would afford protection in cases where crop failures were due to causes other than faulty seed, such as soil conditions, weather conditions, etc. Some have suggested that it acts as a "bluffer," especially where only small investments are involved. That it has weight in some of our courts cannot be denied. This is evidenced by decisions handed down by the courts in Wisconsin (1), Connecticut (2), Washington (3) (4),

California (5) (6), and Iowa (7) which in general upheld the disclaimer clause. Other courts, Ohio (8), South Carolina (9) (10), and South Dakota (11) have ruled that in order for the disclaimer clause to be effective it must be brought to the attention of the buyer at the time of sale. Merely having it printed on the stationery and catalogue did not constitute bringing the disclaimer to the attention of the buyer. A decision handed down by the Supreme Court of New York (12) gave no weight to the disclaimer; however, when the case was appealed to the Court of Appeals the decision of the lower Court was reversed and the disclaimer upheld. As to what protection the disclaimer will afford the selling seedsman in other states, not mentioned above, will depend upon the courts in those states.

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SEED INSPECTION IN CANADA

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The organization for seed control in Canada is Dominion wide. The Seeds Act applies to all Canada. There are no laws in the provinces concerning the sale of seed for seeding purposes.

In regard to importations, it should be pointed out that the law applies to seed for the purpose of seeding by the importer as well as that to be sold, offered, exposed, or held in possession for sale for seeding purposes.

It is not the writer's desire or intention to compare the system in Canada with that of another country but he does not hesitate to state that in his opinion one Act for all Canada is preferable to one for each province. Some of the advantages are: 1. Reduction in cost of control by elimination of the need for several organizations since one only is required as against nine, with one for each province; incidentally, duplication of effort in the Dominion as a whole is prevented. 2. The law can be framed for the common good of Canada but at the same time the needs of each province can be considered and provided for. 3. The interests of merchants are considered. The matter of adherence to regulations is much simplified when the law applies to the whole country.

Our organization is the Dominion Government, in the Cabinet Council of which is the Minister of Agriculture as head of the Department of Agriculture and whose chief assistant is the Deputy Minister of Agriculture. The

department is divided into several branches including the Seed Branch at the head of which is the Seed Commissioner who, under the direction of the Minister through the Deputy Minister, is responsible for the enforcement of the Seeds Act, also the enforcement of other laws, control of other products and work related thereto namely:—the Feeding Stuffs Act, the Fertilizers Act, the Agricultural Pests' Control Act, Control of the Sale of Binder Twine, and Inspection of Hay and Straw.

The Seed Commissioner is stationed at Ottawa, the seat of Government for Canada, and is supported by the required staff of officers.

In Canada, the analytical work and inspection are divided. Therefore, supporting the Commissioner in the organization are a Chief of the Seed Division and a Chief Seed Analyst. The present incumbent of the last named position is Mr. W. H. Wright, a past president of your association who is attending your annual meeting.

In the Dominion, there are seven districts of the Seed Branch which may be described by provinces although the boundary line in some instances is not the line between provinces. The districts are:—

No. 1—The Maritime Provinces; Nova Scotia, New Brunswick and Prince Edward Island; No. 2—Quebec; No. 3—Eastern and Northern Ontario; No. 4—Western Ontario; No. 5—Manitoba; No. 6—Saskatchewan; No. 7—Alberta and British Columbia.

The last mentioned district is to be divided in the near future, in which case the number of districts will be eight.

In each district there is a laboratory division and an inspection division. The laboratory is provided in order to make provision for the analysis of samples as required, (1) by growers for information in regard to seed produced or for information in securing the proper quality of seed for planting, (2) by those who desire to sell seed for seeding purposes in the country or to export, (3) in official samples taken in connection with the enforcement of the Seeds Act and samples taken from shipments of seed offered for importation; also those taken for the purpose of investigation.

The personnel of the laboratory consists of a Supervising Analyst, responsible to the Seed Commissioner through the Chief Seed Analyst, for the general management of the laboratory and the analsyis of samples, and a staff of analysts the number of which depends on the district requirements for seed analysis.

At the head of the inspection division is the District Inspector who is under the direction of an responsible to the Seed Commissioner for the general management of the inspection work in the district. The inspection district is divided into sub-districts with an inspector in each under the direction of the District Inspector. The office of the District Inspector is in the same building as that of the Supervising Analyst and the laboratory.

The enforcement of law in the district is the responsibility of the District Inspector which allows the Supervising Analyst and his staff to devote full time to analysis and work relating thereto. In fact all samples, official and others, are received by the staff of the inspection division, and recorded, and each sample is given to the laboratory division with the required information on a form known as "Certificate of Analysis" which bears the same number as that under which the sample is recorded. On completion of the test or tests, the sample and certificate are returned to the inspection division for filing following grading, if required, and reporting. The report is

made out on what is known as a certificate of grade, in connection with which are given details of analysis.

That, in brief, is the organization which has proved very satisfactory in Canada but which, as it now stands, is the result of many changes and which will, no doubt, be altered to some extent when any need for change is apparent. However, the general principal is likely to remain.

The law in Canada differs in many respects from that of other countries because it provides for the sale of seed under grade, in some cases optional, in others compulsory, but in all cases except one the minimum requirements for seed of the lowest grade, i. e. No. 3 or No. 3 Mixture, represents the minimum quality of seed of the kind which may be sold legally for seeding purposes in Canada. The exception is in regard to rape, mangel, beet, turnip, swede, carrot, parsnip, radish, onion, tomato, and other kind or kinds of field root or garden vegetable seeds that may be prescribed by regulation.

In the Act, the Minister of Agriculture is given authority to make certain regulations, including the kinds of seeds to which certain sections apply, which accounts for the reference to other kind or kinds prescribed by regulation.

The regulation is—

"3. The Minister may appoint an advisory board which may at his request prepare and recommend to him such regulations as it is of opinion should be established under this Act, and may make regulations prescribing

(a) the minimum quality for seeds that may be sold under the grade names prescribed under the provisions of this Act, the kinds of seed to which sections five and six of this Act shall apply, other than those named therein, and to modify such minimum quality for any period of time or territory."

Some of the most interesting sections of the Act to those in attendance at this convention are:

"5. No person shall sell, offer, advertise, expose or have in possession for sale for the purpose of seeding in Canada any seeds in containers containing seeds of clover, alfalfa, grasses, flax, sorghums, millet, wheat, oats, barley, rye, corn, buckwheat, sunflower, field peas, field beans, vetches, or other kinds of seeds that may be prescribed by regulation, nor shall any shipment be billed as seed unless each container containing such seed, or a tag or label durably attached thereto, is branded or marked on one side in printed characters, in such form and manner as may be prescribed by regulation, with the following information only:—

(a) the name and address of the seller;
(b) the name of the kind or kinds;
(c) the brand name if any;
(d) the name of variety, when known;
(e) the name of the grade of seed, which shall be one of the following:—

(I) for the general seeds of commerce, No. 1, No. 2, No. 3;

(I) for seed derived from an inspected seed crop that was pure as to variety and was registered by the Canadian Seed Growers' Association, Registered No. 1, Registered No. 2, Registered No. 3, to which grade names there may be added such further word or words as may be prescribed by regulation to describe such damage to the seed as may not impair its utility value for seeding;

(III) for mixtures of grass, clover, or other fodder or forage crops seeds, No. 1 Mixture, No. 2 Mixture, No. 3 Mixture;

(f) the serial number of the control sample certificate or the letter and serial number of the seed inspection certificate;

(g) the origin of production for the kinds and in the manner as may be prescribed by regulation.

"6. No person shall sell, offer, advertise, expose or have in possession for sale for the purpose of seeding in Canada, any seeds in containers containing more than two ounces of seeds of rape, mangels, beets, turnips, swedes, carrots, parsnips, radish, onions, tomatoes and other kind or kinds of field root or garden vegetable seeds that may be prescribed by regulation, unless they conform to the minimum standard of purity and vitality that may be prescribed by regulation, or are graded and marked in accordance with section five of this Act, or if not graded, a tag or label, durably attached thereto, is branded or marked on one side in printed characters, in such form and manner as may be prescribed by regulation, with the following information:—

(a) the name and address of the seller;

(b) the name of the kind and variety;

(c) the year in which the container was filled;

(d) the percentage of germination when such germination is below the minimum percentage of germination prescribed by regulation for seed of the kind.

"10. No person shall sell, offer, expose or have in possession for sale for the purpose of seeding in Canada any seeds or plants that are falsely represented in any form of advertising or otherwise as to quality, grade, character, nature, variety or description of seeds or plants of any kind or variety, nor shall cereal grains, grasses or clover seeds be advertised for sale at a stated price unless the grade name is included in the advertisement.

"12. No person shall sell, offer, expose or have in possession for sale for the purpose of seeding in Canada any seed or mixture of seeds of a quality inferior to No. 3 or No. 3 Mixture, or to the minimum standards of purity that may be prescribed by regulation for seeds offered for sale under sections six and seven of this Act; such inferior seeds shall be designated as Rejected.

"13. No person shall import into Canada for the purpose of selling or offering for sale, or for the purpose of seeding, any of the seeds named in section five of this Act, or any kinds of garden vegetable seeds that may be prescribed by regulation, unless they are branded or marked or coloured in accordance with the provisions of this Act and conform to the regulations thereunder."

The exemptions are given in Section 14 which reads:

"Sections five, six and seven of this Act shall not apply to,—

(a) seed that is sold to be cleaned or graded before offered for sale for the purpose of seeding;

(b) seed that is held in storage for the purpose of cleaning or grading, provided that the place of storage is not accessible to purchasers of seed or the seed is labelled "held for recleaning";

(c) the seeds of cereal grains, buckwheat, field peas, field beans and corn that are grown, sold and delivered by any farmer, on his own premises, for seeding by the purchaser himself, unless the purchaser of

the said seeds obtains from the seller at the time of the sale thereof a certificate that the said seed is supplied to him subject to the provisions of this Act;

(d) the sale of Elite stock seed that may be produced and sold by any plant breeder to a seed grower, unless such seed be again sold."

An interesting section of the Act is 17 where an attempt is made to place responsibility in connection with seed sold. This section reads:—

"(1) No proceeding to enforce a penalty provided for violation of a provision of this Act, in respect to any official sample of seeds or plants taken and sealed for testing or grading under the provisions of this Act, shall be instituted against the person resident in Canada from whom the seeds or plants were purchased when

(a) the seeds are in sealed containers and have been in the possession of such person for more than six months, or

(b) the seeds or plants are not in sealed containers and have been in the possession of the said person for more than fourteen days.

(2) If the said person satisfies the inspector or magistrate before whom the proceeding has been instituted that

(a) the seeds or plants were purchased by him directly from a person domiciled in Canada;

(b) the containers if sealed were not opened nor the state of the seeds or plants altered while in his possession;

(c) he had no reason to believe that such official sample did not comply with the provisions of this Act;

and shall disclose the name and address of the person from whom he purchased the same, and the place and date of the sale thereof to him, he shall not be liable to prosecution as hereinafter provided.

(3) If, however, the seeds or plants were purchased from a person not resident in Canada the complaint made shall be against the person in whose possession they are found."

In the regulations made in pursuance of the Seeds Act is included the definition of grades which is—

"The minimum quality for seeds that may be sold under the grade names prescribed under section 5, clause (e) of The Seeds Act shall be as follows: Registered No. 1, Registered No. 2, and Registered No. 3 grades shall be derived from a seed crop for which a Crop Registration Certificate has been issued, and shall be sealed in containers by an inspector with a seal approved by the Minister; and seed derived from a seed crop for which a Seed Crop certificate has been issued, and graded No. 1, No. 2, or No. 3, shall be sealed in like manner. All grades shall consist of seed which shall (1) within comparative latitudes for different grades be well matured, plump, sound, sweet, and well cleaned and graded to remove small, shrunken, immature or broken kernels and inert matter; (2) be at least equal in general appearance to standard grade samples that may be fixed from season to season; and (3) comply with the minimum standards set forth in the following tables."

The tables referred to indicate the maximum number to the ounce or to the pound of weed seeds allowed and the minimum percentage germination or minimum percentage pure living seed required for each grade of the various kinds of seed to which the Act applies. In the case of Field Root and Garden Vegetable seeds, the minimum quality stated for grade No. 3 for seed of the kind indicates the quality required for seed which may be sold legally for

seeding purposes in Canada in so far as general quality and impurities are concerned and, in the case of vitality, that which may be sold without being labeled with the percentage germination.

Penalties are provided for illegal sale, default of immediate payment of fine imposed, forging or altering of any certificate number or document issued under the provisions of the Act, willfully lowering the quality or value of seed by mixing with other seed or material after the seed has been tested and marked as required by the Act, willfully obstructing, hindering, resisting, or in any way opposing an inspector charged with the enforcement of the Act while in the discharge of his duty.

Provision is made that in any prosecution under this Act or of regulations prescribed hereunder, the certificate of grade of an inspector and the certificate of test or analysis of an official analyst on any sample of seeds or plants received under the provisions of this Act, shall be accepted as prima facie evidence of the particulars of the said certificates as therein set out.

In Canada there is a procedure adopted in the interest of crop improvement through what is known as the Canadian Seed Growers' Association and provision is made in the Seeds Act for grading of seed grown under the rules and regulations of this Association. This seed, known as registered, must have a pedigree or history, be descendant from Elite stock, described as Selected seed or plants produced by plant breeders the product of which may be eligible to produce registered seed, and it is sold only in sealed containers.

In connection with the production of registered seed, crop inspection is necessary and inspectors of the Seed Branch perform this duty. The Association assumes responsibility for the issuing of a crop certificate required by the grower in connection with each crop before the seed produced can be considered eligible for inspection with the idea of sealing as registered. It is the duty of inspectors of the Seed Branch to make final examination and to seal such seed if found satisfactory.

No doubt, each of you at this meeting has a very clear understanding of the position of a manager of a company organization or business. Therefore, it is easy to size up the situation of the District Inspector responsible for the enforcement of the Seeds Act under the direction of the Seed Commissioner and other related work in the interest of crop improvement. It is perhaps more difficult, without practical experience, to size up the situation of the inspector. From experience, the writer has learned that the best results are obtained by placing on the inspector the responsibility for the enforcement of the law in the territory allotted to him. He is provided with all information available, with equipment required, and a motor car as a means of transportation. He is instructed that while it is the little things in life that count, the reference in the case of seed inspectors applies to the general operation of an individual organization or company, rather than any single transaction which might mean a violation of law.

Inspectors of our district agree that much can be accomplished by cooperative effort. And, where this is practiced, better results are obtained than from the enforcement of law without due consideration of all circumstances and due allowance for natural variability in tests and for human error.

Owing to the short time devoted to the sale and delivery of seed, it is impossible to maintain a staff sufficient to make an inspection of each shipment. Therefore, each inspector is responsible for a much larger territory than is the case when inspection of each shipment is possible.

In the circumstance, it is essential that each inspector know his territory, its potentialities and its needs, and that he familiarize himself with the method of operation of each dealer who may be a grower, a wholesaler, or a retailer. He must be tolerant but firm in the discharge of his duties, and he should at all times be prepared to offer suggestions for improvement. Each case with which he deals must be treated on its own merits, and due consideration must be given to all angles of the case. Unless this is done satisfactorily, there is danger of persecution in prosecution.

There is need for close contact between the District Inspector and the inspector. It is essential that the inspector be assured of the support of his superior officer including protection, through advice and criticism, of all his efforts; that he have definite knowledge of the general policy of the Branch in all matters pertaining to inspection; and that he be given all information available as to the results obtained by his associates.

Much can be accomplished through conferences of inspectors, which give to each an opportunity to compare notes with others in the same work and, in a group, secure from the officer in charge his opinion as to methods of procedure, criticism to be made, and results in general obtained.

This outline of procedure represents as clearly as I can indicate that adopted in my district, but is not by any means the whole story. So much depends on the individual that it is impossible to give any outline for procedure to attain success in a case where there is not any discrimination in the selection of a man for the position. It is true, practice makes perfect but it is next to impossible for an inspector to practice for perfection without having the many general qualifications for the position. Two essentials for the position, in my opinion, are—a suitable personality and a consciousness of the needs of agriculture. In my opinion, the inspector who has practical experience in farming has an advantage over those who have not, although this has not been proved to be an essential.

In Canada, our Act is lacking in that no provision is made for seizure or detention except in regard to seed being imported. This, we believe necessary and, no doubt, in the future provision will be made for it.

Another matter to which reference should be made is advertising. Some would refer to this as education but as the writer has been a farmer, a producer, and a purchaser of seed, and has some understanding of the farmer, he refuses to admit it is all education. He prefers to appeal to the farmer's better judgment and wisdom in the value of the use of good and suitable seed. The writer believes our Government would be acting in the interest of crop improvement in Canada if more reference were made in farm journals, radio talks, and in any other suitable way, to the value of the use of high quality seed.

SEED INSPECTION IN NEW YORK STATE

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The purpose of a seed control law is to protect both the seed-buying public and the vendor who sells properly labeled seeds. The seed law in force in this state is essentially the uniform state seed law in that the labeling principles of the uniform law are articulated into the agricultural law of the state. The law provides for labeling, for analysis, for publication of results, for the prevention of misrepresentations, for seizure under certain conditions, and for the creation and maintenance of a seed testing laboratory and of control fields.

In a general way, the work is divided into two phases, viz., the inspection work conducted by the Department of Agriculture and Markets at Albany, and the technical or analytical field and laboratory work done by the Division of Seed Investigations at the State Experiment Station at Geneva.

It is the work of the inspectors to visit all places where seeds are sold, to take samples at their discretion in order to check the practices of dealers, including written and verbal statements, and to determine whether seeds are being offered for sale to the public in accordance with the provisions of the law.

In the course of the inspection work one soon finds that there are many classes of dealers ranging from those who have never heard of the seed law to those who are fully posted on methods of seed merchandising, analyzing, and labeling. The vendor's knowledge of the commodity he is selling is generally reflected in the way in which he offers his stock for sale. Certainly there seems to be a great opportunity for wholesalers to acquaint their retailers with proper methods of vending. It would seem to be worthwhile for wholesalers to place in the hands of their retailers a brief statement of what they are doing to supply them with proper and legal label statements and to urge their cooperation in carrying out the intent and letter of the seed control law.

There are some vendors who evade certain requirements of the seed law. As an illustration of this, one might cite the usual sequence of events which follow when an inspector goes into an elevator or feed store to secure samples of springs grains. An elevator man may have one or more cars of oats which he may imply are "good for seed" or "suitable for seed". When a sample is procured, analysis made, and legal processes have started, he sometimes replies that this stock was not offered "as seed". From that time on he is careful to state that he has "no seed oats for sale", but in his conversation he may lead a farmer to believe that they are "good oats" and it usually follows that a sale is made. Other evasions are the use of round numbers or blanket figures for purity and germination guarantees. For example, some vendors label all containers of vegetable seeds with, "germination 50%"; some vendors label field corn and field beans "Purity 98%, Germination 90%". Seed inspectors are discouraged when it seems that the farmer or gardener does not take full advantage of the protection offered under the law. Undoubtedly many irregular practices could be eliminated if purchasers would cooperate with seed control officials.

Even though our seed law is confined to New York State, there are

frequent opportunities for us to cooperate with the Federal Division of Seed Investigation in obtaining evidence concerning seeds shipped directly to farmers from another state. Such cooperation not only assists the Federal Government but it also receives the full approval of local dealers who must meet the requirements of the state law. In fact, there are many opportunities for the inspector to act as an ambassador of good will and to perform a certain amount of educational work, as well as to secure the necessary samples. Actually, then, the seed inspector's job may become very largely market inspection, with the taking of samples only incidental where there seems to be a definite need therefor.

If one may judge from the demands of vendors, there is urgent need for prompt information on the findings in any case under investigation. The most useful information is that which comes promptly and which indicates to the vendor what he can do to improve his merchandising methods, and how he can enhance the value of the seed stocks which he sells, since after all, an increasing number of seed dealers aim to sell the best kinds of seeds adapted to their particular locality.

The adoption of a policy to cover the seed inspection work is highly important. Experience shows that much depends upon the seed inspector himself whether or not the enforcement agencies gain or lose the confidence and good will of the vendor. If the law is just and equitable, enforcement will gain the favor and support of the majority of vendors.

The picture is only complete when there is full and prompt cooperation between the inspection service and the testing laboratory. The confidence of the vendor will be secured when he realizes that there is such full and close cooperation between these two agencies and when there is a real effort made to understand what is best for the seed program of the state.

THE INTERSTATE CLAUSE OF THE FEDERAL SEED ACT TO DATE

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The interstate clause of the Federal Seed Act became a law on April 26, 1926. This followed years of discussion relative to various proposals, all designed to improve the situation with respect to the misbranding of seed in interstate commerce. At the time the interstate clause of the Federal Seed Act was proposed there appeared to be two divergent views as to the best possible procedure. One called for compulsory labeling of all seeds shipped in interstate commerce. The other called for an inspection of seeds shipped in interstate commerce and publication of instances where seed was found to be adulterated or misbranded. The resulting act appeared to be a compromise between these views.

It was assumed that seed shipped without labels in interstate commerce would be labeled by the consignee to comply with the State seed law. The person responsible for the labeling would then be subject to the State law. If, however, the seed was labeled or otherwise branded in interstate commerce

the person responsible for the labeling or branding would be outside the jurisdiction of the State law but would be subject to the Federal Seed Act.

It seems appropriate, after ten years of its existence, to review the activities that may lead to better judgment as to whether or not the interstate clause of the Federal Seed Act serves the intended purpose.

On June 1, 1936, recommendations that action be taken under the interstate clause of the Federal Seed Act had been made in 220 instances. The misbranding in the 284 shipments involved were distributed as follows:

155 were misbranded as to Germination.
61 were misbranded as to Purity.
57 were misbranded as to Noxious Weed Seeds.
49 were misbranded as to Variety.
47 were misbranded as to Weed Seeds.
20 were misbranded as to Inert Matter.
10 were misbranded as to Origin.
4 were misbranded as to Other Crop Seed.

A number were misbranded in respect to more than one item.

Recommendations for seizure were made in 143 instances. These resulted in 99 seizures. The United States marshal was unable to effect the seizure in 17 instances, and 7 were not filed in court. On June 1, 1936, our records did not show what action had been taken as a result of 20 recommendations for seizure more recently made. Because of repeated shipping of misbranded seed, 31 of the seizure cases became involved in criminal actions brought later.

Up to June 1, 1936, a total of 77 prospective criminal cases had been reported to the Attorney General for action. Our records on that date indicated 35 had been terminated with fines imposed by the courts, 29 were pending, 3 were not filed in court, and 2 had been withdrawn. In 4 cases the two defendants involved were found not guilty, and 1 case resulted in a mistrial and was dropped. In 3 cases demurrers filed by the defendants were sustained by the courts.

There have been 83 firms involved as shippers in all the instances where action was recommended. Approximately 32% of the seizure actions and 22% of the criminal actions involve shipments rather evenly divided in number between three of the firms and their affiliates.

The accompanying charts show the States in which the shippers are located and the States in which the seed was found to be misbranded in all cases reported closed and pending as of June 1, 1936. It is interesting to note that in a number of instances the States fall definitely into one class or the other. While there may be a relationship in some instances, it must not be assumed that the activities under the interstate clause of the Federal Seed Act in any one State definitely reflect upon the enforcement of a State seed law. Many States no doubt cope with misbranded shipments in interstate commerce without the assistance possible under the interstate clause of the Federal Seed Act.

The Act has been administered with realization of the existence of State seed laws and has been looked upon as a statute which supplements the enforcement of such laws. Action under the Act has originated from complaints submitted to the Department in practically all cases by the agency charged with the enforcement of the State seed law. This has, in some quarters, created the impression that the enforcement of the interstate clause of the Federal Seed Act is dependent upon the provisions of the State seed laws and

that cases are based on the results obtained by the State seed analysts. This is true to the extent that the State seed law may have contributed to the presence of a label, and the misbranding is usually detected by the State seed analyst. No action has been brought under this provision of the Act without an analysis of the sample being made by the Bureau of Plant Industry of the U. S. Department of Agriculture. In seizure cases, where time is such an important element, the Department has relied on State analyses and made recommendations for seizure. This has been followed, however, with tests made by the Bureau of Plant Industry. Should the results obtained not substantiate the action, the withdrawal of the case would be recommended

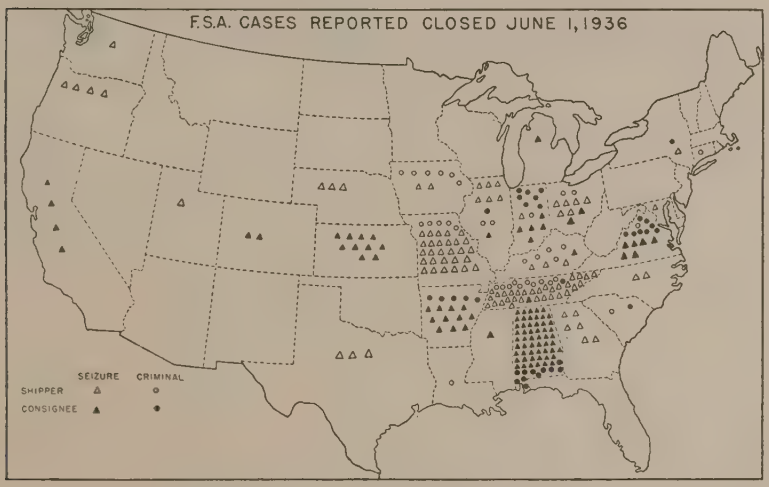
The first Service and Regulatory Announcement reporting cases under the Act was published in October, 1933, and covered the period from July 1, 1931, to June 30, 1933. Due to the time which had elapsed, it was deemed advisable not to include in that publication cases which had been terminated prior to that period. The latest Service and Regulatory Announcement was issued in November, 1935, and covers the period from January 1, 1935, to June 30, 1935. Press releases relative to cases have been issued from time to time when notices of their termination have reached the Department. No publicity has been given by the Department in any case decided in favor of the defendant.

Perhaps the most difficult cases have been those involving seed misbranded as to variety. For a number of years, early maturing soybeans were sold in the South under the names Otootan, Laredo, and Mammoth Yellow. Names have been adopted for two of these varieties of soybeans to avoid the confusion which existed. We have received no complaints in recent years with respect to early maturing soybeans sold under the name Otootan. Rye seed of many types and varieties has been sold in the South under the name Abruzzi. The complaints with respect to northern rye being sold as Abruzzi have been reduced materially in those States which have been active in utilizing the interstate clause of the Federal Seed Act. Seed has been reported to be labeled in germination as low as 66% by a dealer who had been previously approached under the penal provisions of the Act. The State seed analysts or those enforcing the State seed laws are no doubt in a better position to judge whether or not the interstate clause of the Federal Seed Act serves its intended purpose. It is the impression of those close to the administration of the Act that it is having a beneficial effect. It is hoped that regulations the Department expects to promulgate in the near future will assist in its administration and enforcement.

There is still considerable shipping in interstate commerce of seed that is not labeled. This is especially true of shipments by truck and other shipments made directly to the consumer. It would no doubt be difficult for the States to compel labeling of this seed even though it was all subject to the State seed laws. Perhaps a Federal statute providing for the labeling of seeds in interstate commerce would be of assistance. Since the sale of much of this seed is a result of misleading representations it may be that closer supervision should be given to advertising. We must be mindful, however, that efforts to protect the seed buyer have practical limitations. We are of the opinion substantial improvement along this line can not be accomplished as long as the buyer yields readily to the purchase of unlabeled seed, and the seller is permitted to use misleading advertising. Let the buyer beware—the seller be fair!

To constitute misbranding under the Federal Seed Act, representations must be *false and fraudulent*. In seizure cases, where the action is brought against the seed, it seems it should not be necessary as now required under the Act, to prove the misrepresentations were *fraudulently* made. It would appear that when seed is labeled in a *false or misleading* manner it should be subject to removal from sale, at least until properly labeled.

In order to successfully bring action under the penal provisions of the Act it is necessary to prove that the defendant *knowingly* misbranded the seed. Those familiar with the enforcement of law recognize the difficulty of bringing forward such proof. It would seem that persons guilty of making false or misleading representations with respect to seed in interstate commerce should be liable to prosecution when such representations are a result of disregard of their truthfulness.



GROWING TESTS IN AN ATTEMPT TO DIFFERENTIATE *MELILOTUS ALBA* AND *MELILOTUS OFFICINALIS* ON SEED CHARACTERISTICS

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In June, 1932, two referee samples, one a commercial sample of seed of *Melilotus officinalis* and the other a blend of two-thirds *Melilotus officinalis* and *Melilotus alba* were received, with a request to distinguish between the two species on characteristics other than mottling. Although through previous experience this laboratory has found that this cannot be accurately done, we felt the problem was well worth further study.

The following characteristics were used as a basis for division; (a) mottling, (b) position of scar, (c) color, (d) texture, (e) general shape. Separations based on these characteristics were grown to determine the accuracy of the selections.

This experiment has been carried on for three years and the 1936–37 growing tests are needed to complete the study. The results to date show that although a high percentage of accuracy was obtained in the selections, there was enough error to indicate the impossibility of individual seed selections. Of the divisions that were considered definitely as *Melilotus officinalis*, only the mottled seed proved to be entirely yellow-blossomed in all three growing tests. All mottled seed (not only the definitely mottled ones but those that had mottling so faint that high power magnification was required to detect it) produced yellow-blossomed plants. Many of the yellow-blossomed plants had no mottled seed present on them. In all of the divisions, other than those based on mottling, both yellow and white-blossomed plants were found. The divisions that were selected as definitely *Melilotus alba* had an average for the three growing tests of only 66.6% *Melilotus alba*. No mottled seeds were found on any of the white-blossomed plants. The only characteristic found dependable in this study is mottling.

WEIGHT PER BUSHEL OF WHEAT IN RELATION TO ITS SEED VALUE[1]

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Weight per bushel means more to the average farmer than any other test commonly made on wheat. This is especially true where the kernels of wheat are sometimes shrivelled due to rust or other disease or to drouth or frost damage and the weight per bushel is low.

Factors Affecting Weight Per Bushel

The weight per measured bushel of wheat or of any other seed is dependent upon four factors; (a) specific gravity of the individual seeds, (b) average weight per seed, (c) shape of the seeds, and (d) the size of the seeds. The specific gravity or density of seeds in general varies greatly, but that of wheat is fairly constant. Whitcomb and Sharp (4)[3], working with wheat harvested at stages of maturity varying from very young seeds to mature seeds, showed the relationship of test weight per bushel to specific gravity and weight per kernel. The weight per bushel ranged from 40.0 to 63.5 pounds with a difference of 23.5, the weight per kernel from 7.7 to 30.0 milligrams with a difference of 22.3, while the specific gravity ranged from 1.4135 to 1.4180 with a difference of only .0045. These data showed no consistant relationship between specific gravity of seeds and weight per kernel or weight per bushel, but there was a direct relationship between weight per kernel and weight per bushel. These data indicate that weight per bushel of wheat is dependent on weight per kernel and on certain factors other than specific gravity of the kernels.

The size and shape of the seeds determine how closely they fit together when placed in the test kettle and, hence, determine the amount of pore space which any particular lot of seed may have. Rough, angular seeds might be expected to fit together less closely than those having rather even surfaces and hence the seeds having angular surfaces have the more pore space and are of a lighter test weight per bushel. At first thought, small seed would be expected to fit together more closely than large seeds and have less pore space, but such is not the case. This same condition exists with soil. Coarse, sandy soil has been shown to have a pore space of 33 per cent and a weight per cubic foot of 111 pounds, while very fine clay soil has a pore space of 53 per cent and a weight per cubic foot of 79 pounds.

Thus it may be concluded that wheat of heavy weight per bushel is characterized by large heavy plump kernels having rather smooth surfaces and a relatively small pore space, while light weight wheat has small kernels which may have angular surfaces and the pore space is relatively large. The problem then becomes one of determining the relative seed value of large plump kernels and small kernels which may be shriveled.

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[1]Contribution from Montana State College Agricultural Experiment Station. Paper No. 81, Journal Series.

[2]This study was made possible by the employment of students Fred Butler and Howard Hess under the provisions of the National Youth Administration funds.

[3]Numbers in parenthesis refer to Literature Cited.

Another factor which must be taken into consideration is the condition which caused the shrunken seeds. Whitcomb and Sharp (3) working with artificially frosted wheat of the 1923 crop, found that immature wheat having a test weight of 40.0 pounds per bushel had a laboratory germination of 99 per cent and when the same wheat was severely frozen the germination was 0. Other less immature wheat having a test weight of 61.7 pounds had a laboratory germination of 99 per cent before it was frozen and 62 per cent after it was frozen. Johnson and Whitcomb (1), working with naturally frosted and non-frosted spring wheat of the 1924 crop, found that 60 pound per bushel non-frosted wheat, having a laboratory germination of 97 per cent, produced 769 plants per 1/1000 of an acre, while heavily frosted wheat having a weight of 47 pounds per bushel and a laboratory germination of 71 per cent produced 454 plants per 1/1000 of an acre. The rate of seeding in each case was 1 measured bushel per acre. These studies indicated that weight per bushel was fairly good index of seed value when the wheat was frost damaged but not so reliable when it was immature without frost damage.

WORK WITH THE 1935 CROP OF LIGHT WEIGHT WHEAT

The wheat of the 1935 crop was light weight due to rust and heat in North and South Dakota and Minnesota and to drouth in Montana. A special study of the North Dakota wheat was made by Stoa, Brentzel, and Higgins (2). Working with 462 lots of spring wheat, they found the laboratory germination in relation to weight per bushel to be as follows: Above 52 pounds, 87.8 per cent; 48 to 52 pounds, 86.9; 43 to 47 pounds, 82.9; 38 to 42 pounds, 81.2; and below 38 pounds, 81.0 per cent. The relative vigor of plants grown in the greenhouse from North Dakota wheat was indicated by the following weights of 100 plants 14 days after emergence: 60 pounds per bushel, 10.9 grams; 50 to 54.9 pounds, 7.1 grams; 45 to 49.9 pounds, 4.6 grams, and 40 to 44.9 pounds, 3.8 grams. These data indicated that laboratory germination was not greatly affected by weight per bushel but that the vigor of the plants in the seedling stage was directly dependent upon the factor.

EXPERIMENTAL WORK WITH MONTANA WHEAT

One hundred and fifteen lots of hard red spring wheat of the 1935 crop were selected for this study. For the most part, this wheat had been affected by drouth. The weight per bushel ranged from 36.5 to 60.5 pounds and the weight per kernel ranged from 9.0 to 26.5 milligrams. None of the wheat studied was damaged by frost.

Germination tests were made in the laboratory, in the greenhouse, and in the field. The usual laboratory method of prechilling for 4 days and transferring to a constant temperature of 20°C for 3 days was employed. The greenhouse tests were made in flats filled with a soil consisting of half sand and half loam. The temperature of the greenhouse ranged between 20 and 30°C. The seeds were covered to a uniform depth of 2 inches. Counts were made in 2, 3, and 4 weeks after planting. Careful observations on the number of strong and weak plants showed but few weak plants at the end of 4 weeks. The field tests were made by planting the seeds in rows 12 inches apart and the seeds were spaced approximately 2 inches apart in the row. The seeds were covered approximately 2 inches deep and the soil was in good moisture condition. The first count was made 3 weeks after planting, at which time the plants were approximately 6 inches high. The second and last count will

be made when the plants are ripe, at which time the plants will be pulled and the number of heads per plant will be counted and the yield of wheat per row will be determined.

RESULTS

As shown in Table 1, there is no consistant relationship between laboratory germination or greenhouse germination and weight per bushel, but there is a relationship between plants in the field and weight per bushel. The percentage of plants in the field ranged as follows according to weight per bushel of the seed, 58 and above, 62; 55 to 57.9, 61; 50 to 54.9, 59; 45 to 49.9, 53; and below 45, 47. These percentages of plants may be changed somewhat when the second counts are made at the end of the season.

TABLE 1.—*Germination of spring wheat in laboratory, greenhouse, and field as influenced by weight per bushel—1935 crop*

Weight per bushel	Number of lots	Weight per kernel	Laboratory germination	Greenhouse germination	Plants in field
Lbs.		Mgm	%	%	%
58 and above	15	22.2	87	71	62
55 to 57.9	64	19.8	86	72	61
50 to 54.9	17	17.6	89	76	59
45 to 49.9	12	13.2	88	83	53
Below 45.....	6	10.6	79	75	47

Since the heavier weight wheat had the heavier kernels, it seems that the extra amount of food material in the kernel during the seedling stage in the field soil was important but not so in the greenhouse soil.

One lot of wheat at Miles City, Montana, which was damaged by insects so that the resulting crop was very shriveled and tested but 36.5 pounds per bushel and weight per kernel was 9.1 milligrams. This wheat showed a germination of 82 per cent in both the laboratory and greenhouse, but only 48 per cent in the field.

The number of seeds per bushel of wheat is increased in proportion as the weight per bushel decreased. This is of importance when considering the number of seeds placed on each square foot of ground when seeded at the rate of 1 bushel per acre. The weight per bushel in relation to plants per square foot is as follows: 58 pounds, 27 seeds; 55 pounds, 30; 50 pounds, 37; and 45 pounds, 41 seeds. It is apparent that this increased number of seeds in light weight wheat may compensate for the lower germination in the field and consequently light weight wheat may be seeded at the same rate as the heavier weight wheat, provided the germination is fairly good.

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COMPARATIVE ABSORPTION OF WATER BY ENDOSPERM AND EMBRYO OF CORN KERNELS[1]

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Late in December of 1935 considerable irregularity and unevenness of germination of corn kernels was noted when the kernels were placed on top of moist blotters. Kernels placed either side by side or on opposite sides of the seed tray varied in time required for the emergence of the radicle, plumule and secondary root system. Some kernels, which later were shown to be viable, did not show signs of germination for two to four days after others had developed both a radicle and plumule. Samples placed on trays in the upper part of the germinator showed less unevenness than did those near the bottom. This latter condition was first thought to be due to carbon dioxide accumulation, but the installation of an exhaust fan did not improve the results appreciably except that differences in temperature between the upper and lower trays were less than before. Close observation of the samples indicated that those kernels with embryo side down germinated sooner and exhibited stronger germination than did those with the endosperm side next to the moist blotter. A similar condition was noted by Toole (4)[2] who found that those kernels placed with the germ in contact with the moist substratum showed the first signs of germination in about 24 hours, while those with the germ upward were fully 48 hours in reaching the same degree of development. A difference in the amount of water absorbed by the different sides of the corn kernel was also noted. Bakke and Erwin (1) found that dent corn immersed in distilled water increased in weight by 73.7 per cent. The rate of absorption was found to be 50 per cent in 28 hours. The observations referred to led to the investigations reported in this paper, the objectives of which were to determine what differences were exhibited by corn kernels with the embryo or endosperm in direct contact with the moist substratum as to amount of water absorbed, rate and percentage of germination, temperature effects, living or dead embryos and treated versus untreated seed.

Materials and Methods

The corn used in the absorption tests consisted of both inbred lines and open pollinated varieties selected from laboratory service samples. The seed for each test consisted of 20 or 25 kernels obtained by subdivision of the bulk sample passed through the Boerner mixer.

The kernels in question were placed on small, four-inch square blotters in blue grass germinator trays recently described by Brown and Porter (2). By means of this type of tray a reasonably uniform moisture supply could be maintained. The germinator trays were in turn placed in thermostatically controlled incubators. Each test was made in duplicate, extending over a period of 48 hours. Weighings to 0.0001 gm. were made in air-tight weighing bottles before the start of the test, after 24 hours and again after 48 hours.

[1]Journal Paper No. J377 of the Iowa Agricultural Experiment Station. Project No. 427.
[2]Number in parenthesis refer to Literature Cited.

All tests were run at 30°C unless otherwise stated and the percentage of moisture absorbed was computed from the original weight of the sample of seed in question. The treated seeds were prepared by adding the required amount of mercury dust to the seed in a bottle which was rotated on a seed treatment machine described by Porter (3).

The absorption tests here presented were arbitrarily divided into three groups and will be discussed in the following order: (a) corn from inbred lines, (b) random samples of open pollinated corn, treated and untreated and held at different temperatures for the duration of the test, and (c) random samples of open pollinated corn in which the embryo had been killed by subjecting the seed to a temperature of 180°C for 10 minutes.

EXPERIMENTAL RESULTS

The results of the first group of tests in which corn from an inbred line was used are shown in Table 1. It may be noted in experiment 1 that at the end of 24 hours the kernels with the embryo down absorbed 31.75 per cent moisture, based on the original weight of the seed, while those with the endosperm in contact with the blotters absorbed 31.33 per cent. The difference is not significant. However, at the end of 48 hours, those kernels with the embryo down had absorbed 51.41 per cent, or 11.83 per cent more than the kernels placed endosperm down. It should also be noted in experiment 1, Table 1, that when the embryos of the seeds were placed against the blotter the radicles of 32 and 98 per cent of the kernels had emerged in 24 and 48 hours respectively, while only 2 and 32 per cent of the radicles had emerged in 24 and 48 hours from those kernels placed with the endosperm down. Similar results are shown in experiment 2, Table 1.

TABLE 1.—*Absorption of water through the embryo and endosperm of corn kernels in 24 and 48 hours at 30° C.*

Experiment number	Number of kernels	Original weight in grams	Per cent water absorbed		Per cent germination	
			24 hours	48 hours	24 hours	48 hours
			Embryo down			
1	25	7.2864			28.0	96.0
	25	7.8162	31.74	51.41	36.0	100.0
2	20	5.8726			35.0	70.0
	20	5.6799	34.06	48.64	25.0	55.0
			Endosperm down			
1	25	7.9165			—	20.0
	25	7.5574	31.33	39.58	4.0	44
2	20	6.1996			5.0	15.0
	20	6.0518	29.50	31.15	—	5.0

Table 2 records the results of the tests included in group 2 wherein random samples of open pollinated corn, treated and untreated, were tested at different temperatures for moisture absorption both with the embryo and with the endosperm down. It should be noted that in every case the highest percentage of moisture was absorbed when the corn kernels were placed with the embryo side in contact with the blotter. Furthermore, the highest germination was recorded from the seed placed embryo down.

TABLE 2.—*Absorption of moisture by treated and untreated corn kernels, placed on blotters with embryo and endosperm down at temperatures of 30°, 20°, 10° and 5° C.*

Experiment number	Temperature °C.	Treatment	Number kernels	Original weight in grams	Per cent water absorbed		Per cent germination	
					24 hours	48 hours	24 hours	48 hours
				Embryo down				
1	30	NT†	20	5.5017	25.70	39.25	10.0	90.0
		Tr	20	5.5846	23.98	38.41	25.0	90.0
2	30	NT	20	6.1520	28.46	31.44	15.0	75.0
		Tr	20	6.0978	26.04	30.97	25.0	55.0
3	30	NT	20	6.2612	34.53	47.37	——	30.0
		Tr	20	6.2165	34.42	45.44	——	45.0
4	30	NT	20	4.8022	30.34	45.98	10.0	95.0
		Tr	20	5.2741	33.12	47.26	45.0	100.0
5	20	NT	20	5.1929	24.99	34.80	——	55.0
		Tr	20	4.8600	29.31	37.52	——	70.0
6	20	NT	20	6.6535	17.79	22.79	——	——
		Tr	20	6.4535	18.56	23.24	——	10.0
7	10	NT	20	5.1981	18.08	27.40	——	——
		Tr	20	6.1777	16.48	24.64	——	——
8	10	NT	20	5.1528	18.12	26.09	——	——
		Tr	20	4.8859	19.97	27.64	——	——
9*	5	NT	20	6.4764	——	15.4	——	——
		NT	20	6.2107	——	11.3	——	——
Summary		NT	160	44.9144	24.57	34.27	4.37	43.12
		Tr	160	45.5501	25.08	34.60	11.87	46.25
				Endosperm down				
1	30	NT	20	5.8192	18.56	28.82	——	5.0
		Tr	20	5.6488	17.37	28.18	5.0	5.0
2	30	NT	20	6.0432	21.81	21.81	——	——
		Tr	20	5.5822	21.79	23.84	5.0	5.0
3	30	NT	20	6.4713	26.47	36.48	——	——
		Tr	20	6.1690	31.51	42.49	——	15.0
4	30	NT	20	5.2408	24.77	32.42	——	5.0
		Tr	20	4.8658	36.23	48.09	5.0	35.0
5	20	NT	20	5.2681	22.59	29.22	——	——
		Tr	20	4.7425	24.48	31.26	——	——
6	20	NT	20	6.5550	14.15	15.78	——	——
		Tr	20	6.1803	15.18	17.41	——	——
7	10	NT	20	5.4865	15.89	23.37	——	——
		Tr	20	5.1497	17.13	26.12	——	——
8	10	NT	20	5.1697	14.95	21.47	——	——
		Tr	20	5.4941	16.36	22.47	——	——
9*	5	NT	20	5.8598	——	7.4	——	——
		NT	20	6.0938	——	7.4	——	——
Summary		NT	160	46.1538	19.93	26.12	——	1.25
		Tr	160	43.8324	22.33	29.63	1.87	7.50

*Not included in summary.
†NT—No treatment.
Tr—Treatment.

The summary of Table 2 shows that under all conditions included in the tests, 160 untreated corn kernels placed embryo down, absorbed in 24 hours, water equal to an average of 24.57 per cent of their original weight; and that the radicles of 4.37 per cent of the seeds had emerged. On the other hand, the seeds placed endosperm down absorbed 19.93 per cent of their original weight

in 24 hours and no emergence of radicles was recorded. At the end of 48 hours the seeds placed embryo down had absorbed moisture equal to 34.27 per cent of their original weight, with the emergence of 43.12 per cent of the radicles; while those seeds with endosperm down had absorbed 26.12 per cent moisture, with the emergence of only 1.27 per cent of the radicles.

Similar results are recorded in the case of seed treated with a mercury dust. Those placed embryo against the blotter absorbed 25.08 and 34.60 per cent moisture in 24 and 48 hours respectively, with the emergence of 11.87 and 46.25 per cent of the radicles. The seed placed endosperm down absorbed 22.33 and 29.63 per cent in 24 and 48 hours, with the emergence of 1.87 and 7.5 per cent respectively of the radicles.

It has long been observed in our laboratory that certain mercury dusts, unless used in excess, not only increase the rate but also the total percentage of germination. Such results are easily explained when obtained with diseased samples of corn. A similar response has been observed when nearly disease-free samples of corn are treated, and, as yet, no explanation for this latter condition has been offered. In this connection it is interesting to observe that the treated kernels absorbed a higher percentage of moisture than similarly placed untreated seed although the average difference in water absorption of treated and untreated lots placed embryo down is slight.

Table 2 also shows that as the temperature at which the seeds were held is lowered, the percentage of moisture absorbed is reduced and likewise the rapidity of germination. A comparison of experiments 4 and 8 in Table 2 shows that the absorption of moisture at 30° C was practically double that at 10° C in both 24 and 48 hours, when the seeds were placed embryo down. However, when the seeds were placed endosperm down the difference was not so great, approximately one-third more absorption of moisture occurring at the higher temperature.

While the percentage of kernels which germinate in 48 hours with the embryo placed against the blotter is much higher than that of an equal number of seeds placed endosperm down, the length of radicle at the end of 48 hours should also be noted. Although no measurements of radicle length were made, an examination of Figure 1, a photograph of a tray of corn after 48 hours at 30° C will show the characteristic difference in radicle length between kernels placed on the blotter embryo down and those placed endosperm down.

The corn used in experiment 3, Table 2, was severely infected with *Gibberella saubinetii*, the organism causing Gibberella dry rot of corn. It may be noted that no significant difference in moisture absorption was obtained as between diseased seed in experiment 3 and disease-free seed in experiment 4, Table 2. However, the percentage germination of the diseased seed seemed to be markedly lowered by the pathogen.

The corn used in test group 3 and recorded in Table 3 was killed by heating for 10 minutes in an oven held at 180°C. The purpose of such procedure was to determine if the difference in moisture absorption between embryo and endosperm held for only viable seeds or if it held for all corn seed. Table 3 shows results quite similar to those recorded in Tables 1 and 2. It may be noted that the difference in absorption of moisture by the seeds placed embryo down and those placed endosperm down is practically the same as in the case of viable seed, although the total quantity of moisture absorbed is slightly greater in the viable seed, a condition which may be due to the increase in the number of cells of the embryo with a resultant increase in water holding or absorption capacity.

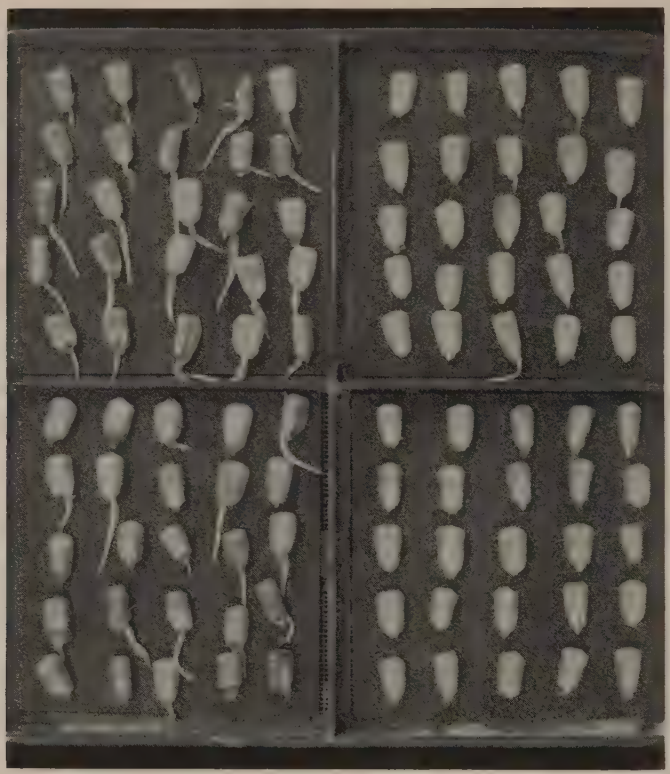

FIGURE 1. GERMINATION OF CORN KERNELS AFTER 48 HOURS AT 30° C.

Upper left—Embryo down, treated.
Lower left—Embryo down, untreated.
Upper right—Endosperm down, treated.
Lower right—Endosperm down, untreated.

DISCUSSION AND SUMMARY

Tests to determine the comparative absorption of water by corn kernels placed with the embryo or with the endosperm next to the moist substratum show that there is only a slight difference in the amount absorbed in 24 hours. However, at the end of 48 hours there is a significant difference in the moisture absorbed, with the kernels placed embryo down consistently showing the more rapid absorption. This might be explained on the basis that when the kernels are placed with the embryo side in contact with the moisture supply, growth processes (accompanied by an increase in size and number of cells which require moisture) begin more rapidly than when the moisture must pass through the endosperm to reach the embryo. The percentage of germination was significantly higher when the kernels were placed embryo down after both 24 and 48 hour periods at 30° C.

TABLE 3.—*Absorption of water through the embryo and endosperm of corn kernels killed by heating to 180° C for 10 minutes.*

Experiment number	Number of kernels	Original weight in grams	Per cent water absorbed	
			24 hours	48 hours
	Embryo down			
1	20	6.7023	25.07	32.63
	20	6.5997	27.49	33.05
2	20	6.4743	27.92	37.07
	20	6.6873	30.48	37.83
3	20	6.5240	27.83	37.30
	20	5.7385	31.22	34.66
Summary	120	38.7261	28.39	35.28
	Endosperm down			
1	20	6.3074	24.01	30.05
	20	6.5682	20.02	26.45
2	20	6.3181	24.78	32.04
	20	6.3505	24.35	32.86
3	20	6.0963	23.58	22.20
	20	6.5955	20.90	16.28
Summary	120	32.2360	23.40	27.62

As the temperature at which the tests were run was reduced, the percentage of moisture absorption and germination was lowered. However, the same relation for moisture absorption of kernels placed endosperm and embryo side down held at all temperatures used.

Treated seed consistently gave a higher percentage of germination than did the untreated, with either the embryo or endosperm in contact with the blotter. Higher increases with treated seed were obtained when diseased corn was used. No significant difference in moisture absorption between treated and untreated seed was found except when the endosperm was placed next to the moist substratum.

Seed with the embryo killed by heating at 180°C and placed with the embryo in contact with the moisture supply, absorbed more moisture than similar seed placed endosperm down, indicating that the corn embryo is a more efficient absorbing organ than is the endosperm.

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GERMINATION OF INJURED WEED AND CROP SEEDS[1]

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Several investigators have supplied data on the germination of hulled grasses, especially timothy. Stevens (3)[3] recently summarized the data to date and presented additional information concerning the germination of old and fresh seeds of hulled timothy, millets and quack grass and broken seeds of flax and several weed seeds. His results show that, on the average, hulled seeds of grasses and buckwheat germinate as well as or better than unhulled seeds. Hulled seeds of wild buckwheat gave 17 per cent germination as compared with 27 per cent for the unhulled. Unfortunately his data are based largely on blotter tests, which are frequently unreliable. Wright (4) summarized the results of tests with quack grass and ragweed made by the Canadian laboratories which showed that hulled seeds from commercial seed samples produced few or no plants. Stahler (2), working with hulled and unhulled quack grass, secured average germination percentages of 3.8 and 57.9 respectively.

The present "Rules for Seed Testing" approved by the Association of Official Seed Analysts provide that all broken crop seeds "when one-half or less" in size shall be classed as inert material. The difficulty in using this rule lies in the interpretation of what constitutes half a seed. In cleaned samples the problem is not an acute one except with flax, sweet clover, sorghum and some of the small grains. The rules further state that "decorticated seeds of Legumes" shall be classed as inert matter, but no definition is given of a "decorticated seed." Presumably the term refers to seeds without a hull or covering, because a seed has no cortex, hence the botanical definition of cortex could not apply. An exception to the rule for decorticated seeds is that of hulled grass fruits which are to be classed as normal crop or weed seeds. The achenes of the Compositae, Polygonaceae, Amaranthaceae and Chenopodiaceae are one-seeded fruits but frequently the pericarp is removed by cleaning machinery leaving the true seed. Is such a seed to be classed as decorticated in the same sense as a legume seed whose true seed coat has been removed? The rules make no clarification, hence it might be difficult for an analyst to know whether a true seed of sour dock (pericarp absent) belongs to the inert material or is to be counted as a weed seed. From the standpoint of the true value of a given seed lot for crop production as well as from the standpoint of law enforcement, it is important to know the viability of broken weed or crop seeds.

The investigations herein reported are preliminary to a more comprehensive study of the viability of broken or injured seeds.

Materials and Methods

The seeds used consisted of broken seeds of alfalfa, sweet clover, sorghum and flax, hulled and unhulled fruits of *Polygonum convolvulus, Rumex cris-*

[1]Journal Paper No. J378 of the Iowa Agricultural Experiment Station. Project No. 428.

[2]Grateful acknowledgment is given to Miss Averil Wright for aid in making some of the purity and germination tests.

[3]Numbers in parenthesis refer to Literature Cited.

pus and *Ambrosia artemisiifolia*, normal and naked fruits of *Chaetochloa lutescens* and *Chaetochloa viridis*, and two types of dodder seeds, one of which appeared to be fertile, the other sterile. Samples of *Chaetochloa viridis*, *Ambrosia artemisiifolia*, sweet clover, flax and alfalfa were the remnants of referee lots used in 1935 by the Research Committee of the Association. Sorghum seeds were saved from service samples, samples of *Polygonum convolvulus* and dodder seeds were obtained from seed companies and fruits of *Rumex crispus* were collected locally.

Germination tests were made between blotters, in 50 mesh quartz sand, in autoclaved soil (equal parts screened sand and loam soil) and in greenhouse pots. Temperatures of germinators in the laboratory ranged from 0° to 30°C. Both alternating and constant temperatures were used.

EXPERIMENTAL RESULTS

Weed Seeds.—Fruits of *Rumex crispus* were collected at Ames, Iowa, in the early summer of 1935. Germination tests on July 18 gave 85 per cent between blotters at 30° C and 89.5 per cent between blotters at alternating temperatures of 20–30° C. The pericarp was removed from each of several hundred fruits by gently rubbing between layers of sandpaper in a small box. Tests between blotters with 100 hulled fruits gave 71.5 per cent germination, but no effort was made at that time to classify the seedlings as normal and abnormal. In October, tests of the normal and hulled fruits between blotters gave 72 and 82.5 per cent, respectively, in laboratory soil 79.5 and 33 per cent, respectively, and in the greenhouse 77.5 and 27 per cent, respectively. The reading made on hulled fruits between blotters included all those which sprouted without reference to strength of germination. A second lot of fruits gathered at a different time gave results similar to those above. Hulled fruits which in July showed 96 per cent germination on blotters, gave in October 19 per cent emergence in laboratory soil and 8.5 per cent in the greenhouse. It is evident that the viability of fruits of *Rumex crispus* is reduced by hulling and storage for three months. The hulling by hand is probably not greatly different from hulling which occurs when such weed fruits are present in crop seed that is threshed. Injury to fruits of *Polygonum scandens* by hulling has been reported by Ransom (1).

Subsequent tests were made with normal fruits and with hulled fruits of two classes: (a) those tested at once and (b) those stored in an envelope 30 days. The substrata used included blotters and soil. Results of these tests are shown below:

Sample No.	Temperature °C.	Substratum	Percentage germination				
			Normal	Hulled—germination at once		Hulled—germination after 30 days	
				Strong	Weak	Strong	Weak
1	20–30	Blotters	90	52	3	–	–
2	20–30	Blotters	99.5	67.5	2.5	–	–
3	20–30	Soil	97.5	56.0	5.0	–	–
4	20–30	Blotters	97.5	—	—	0	51
5	20–30	Blotters	98.0	—	—	0	49

The above results indicate that hulled fruits of *Rumex crispus* have less ability to produce plants than do normal fruits, and further, that the vitality of hulled fruits declines rapidly. No dormancy occurred in the normal fruits, and hulled fruits (seeds) which did not germinate were partially decayed at the end of the test.

The germination of ragweed fruits at alternating temperatures of 20–30° C was preceded by chilling the material at 5° C for two weeks. Three classes were studied; (a) normal, (b) involucre removed, and (c) pericarp removed. The respective germinations, using 300 fruits of each class, were 44, 6.7 and 5 per cent, each of which represents two blotter and one sand test. The results are similar to those reported by others. It is evident that fruits of small ragweed with either the pericarp or involucre removed are extremely low in vitality.

Green and yellow foxtail fruits were divided into two classes; (a) normal and (b) lemmas absent. Many of those without lemmas were embryoless, a condition caused by injury during threshing or cleaning. All lots were prechilled two weeks at 5° C then placed at alternating temperatures of 20–30° C. Prechilling is probably not necessary, at least with old samples.

The results are as follows:

Sample No.	Substratum	Percentage germination of foxtail seeds							
		Normal				Lemmas absent			
		Green		Yellow		Green		Yellow	
		Strong	Weak	Strong	Weak	Strong	Weak	Strong	Weak
1	Blotters	92	4	46	0	11	4	6	0
2	Blotters	90	3	44	2	9	14	2	6
3	Sand	92	0	50	0	4	3	4	8
Average		91.3	2.3	46.7	0.7	8	7	4	4.7

One sample of alfalfa seed received from a seed house contained 24 per cent of hulled fruits of *Polygonum convolvulus*, some of which were placed on blotters and held at alternating temperatures of 20–30° C. Twenty per cent of the seeds sprouted but 19 of the 20 were so moldy and poorly developed that it is probable they had no ability to produce plants. The fruits had been hulled approximately eight months prior to the date of the test. A second test was made with fruits of *Polygonum convolvulus* which were collected by hand in 1934. Two lots from this collection were prepared, one normal, the other rubbed lightly with sandpaper to remove the pericarp from each fruit. A blotter and soil test was made with each lot using 200 seeds for each test. The normal seeds placed at 20–30° C gave 41.5 and 43.5 per cent germination in blotters and soil respectively, whereas the hulled gave 20.5 per cent both in blotters and in soil. Hulling of the fruits of *Polygonum convolvulus* apparently causes injury similar to that with fruits of *Rumex crispus*. All seeds without the pericarp which did not germinate were partially decayed, indicating no dormancy.

Dodder seeds found in commercial seed samples frequently include pale colored seeds, somewhat enlarged or irregular in shape. Germination tests using normal and abnormal seeds were made on blotters and in sand at alternating temperatures of 20–30° C. The normal seeds were divided into three

classes: (a) untreated, (b) sandpapered, and (c) treated with sulphuric acid. The tests of 200 seeds made in sand gave results so close to blotter tests that an average of the two has been made. The results of testing these seed samples of dodder are as follows:

Class or treatment	Average per cent strong seedlings	Per cent hard
Abnormal (sterile)	0	0
Normal	8.4	66
Normal (sandpapered)	58.2	0
Normal (H_2SO_4)	47.2	0

The data shown above indicate that not only do sterile dodder seeds occur in seed samples, but they can be readily detected. If in doubt, a five day test in a petri dish will indicate definitely those that are (a) hard, (b) sterile or (c) permeable and viable. Certainly such abnormal and sterile dodder seeds belong in the inert material.

Crop Seeds.—Germination tests were made with broken seeds of sweet clover, alfalfa, sorghum and flax. In order to check the value of seed lots with broken seeds against the official method of analysis, five purity determinations were made by the official method which requires that broken seeds over half in size be classed as crop seed, and the same number of tests were made by a modified method in which all noticeably broken seeds were classed as inert material. Germination tests of the broken seeds were made in sand and between blotters in two ways; (a) using all broken seeds together and (b) dividing the broken seeds into two classes, one containing those over half size and the other, those half or less in size. A correction in the purity determined by the modified method was made by adding to the pure seed one-half the weight of a normal seed for every normal seedling which developed in the broken seed portions. The arbitrary figure of "one-half" may be too low because for most lots the portion containing seeds over half in size gave the highest percentage of germination. All of the data are presented in Table 1. These show averages of five purity determinations by each method and three germination tests each in sand and blotters. Only strong sprouts are listed and used in determining index values.

From the data presented in Table 1 the following points may be deduced; (a) in general, the percentage purity is higher and the percentage germination is lower for all samples tested by the official method rather than by the modified method; (b) with the exception of sorghum seed, seeds half or less in size constitute the greater portion of the broken seed secured by the modified method; (c) germination in sand and in blotters was nearly the same for alfalfa and sweet clover but was less in sand for the sorghum and flax samples used; (d) most of the germination from broken seeds is given by seeds over half in size with the exception of sweet clover and alfalfa, but the number of plants produced by broken seeds of sorghum and flax is small considering the quality of broken seed present; (e) approximately the same number of sweet clover plants was secured from seeds half or less in size as from portions larger than one-half, but those half or less in size constituted nearly two-thirds of the weight of all broken seeds; and (f) with the exception of flax tested in sand, the index value (purity x germination) secured by the modified method is greater than that by the official method. Present official

TABLE 1.—*Purity and germination tests by official and modified methods with samples containing broken seeds.*

	Sweet clover	Alfalfa	Flax	Sorghum
Pure seed, per cent				
O	93.71	89.4	90.96	91.11
M corrected	91.12	88.6	85.75	86.67
Inert, per cent				
O	6.26	1.87	6.73	8.53
M	11.2	2.64	12.18	14.05
Broken seeds per cent M[1]				
Over half	3.65	1.24	4.11	11.58
Half or less	6.07	1.40	8.33	2.72
Germination				
Sand				
Per cent O	69.1	60.0	59.6	59.1
Per cent M	74.3	72.1	63.0	63.1
Number sprouts, over half	60.5	13.5	6.0	11.0
Number sprouts, broken seeds half or less	67	6.5	0	2.0
Blotters				
Per cent O	69.3	68.8	73.5	63.3
Per cent M	74.6	72.7	81.2	68.4
Number sprouts, over half	49	22.5	21	11.0
Number sprouts, half or less	61	6.0	1.0	1.0
Index values				
Sand				
O	64.5	62.8	57.0	52.2
M	67.9	64.3	54.1	54.4
Blotters				
O	65.4	61.2	63.8	58.1
M	68.0	64.1	70.6	59.0

O—Official method.
M—Modified method.
[1]Per cent by weight of broken seeds secured from bulk lots by modified method. Weight of original samples was 5 grams of alfalfa and sweet clovers, 10 grams of flax and 20 grams of sorghum. Germination of broken seeds represents number of sprouts from portion secured from weights referred to above.

methods do not account for viable broken seeds which are classed as inert, but the differences are not large enough to cause undue concern. If one wishes to determine the true value of a seed sample the modified method has possibilities for samples with many broken seeds or for grasses which contain many empty glumes. The problem of determining when a broken seed is half or more would be eliminated if all noticeably broken seeds were placed in the inert material. A germination test can easily be made to check the viability of the broken seeds. For most samples no correction in purity would be necessary, but the analyst would have evidence that the value given to the seed lot was based on both broken and normal seeds.

SUMMARY

Hulled fruits of *Rumex crispus* used in the experiments reported in this paper showed less ability to produce seedlings in sand than did normal fruits. The viability of hulled fruits declined rapidly from about 80 per cent when freshly hulled to approximately 30 per cent or less after one to three months.

Hulled fruits of *Polygonum convolvulus* secured from alfalfa screenings produced one per cent strong and 19 per cent weak seedlings in sand. Hulling

occurred at least eight months prior to the test for viability. Fruits hulled by rubbing between sheets of sandpaper germinated 20.5 per cent in sand and blotters as compared with 40 per cent for normal fruits.

Naked fruits of *Chaetochloa lutescens* and *Chaetochloa viridis* secured from commercial seed lots germinated 4 and 8 per cent respectively in comparison with 46.7 and 91.3 per cent each for the fruits with lemmas attached. Many naked fruits in commercial seed samples are without an embryo.

Normal fruits of *Ambrosia artemisiifolia* germinated 44 per cent, whereas fruits injured by mechanical removal of the involucre and pericarp germinated about 6 per cent in sand.

Pale colored dodder seeds somewhat irregular in shape or enlarged were incapable of germination. Such seeds can be readily detected, but in case of doubt a five day test in the germinator will determine those which are nonviable.

Hulled fruits of sour dock, black bindweed, small ragweed, naked fruits of green and yellow foxtail and sterile dodder seeds found in commercial seed samples showed little or no ability to produce plants. For all practical purposes part or all of such fruits and seeds may be classed as inert.

Broken or injured crop seeds when present in quantities of 5 per cent or more of the seed sample to be tested are difficult to classify by the present Rules of the Association of Official Seed Analysts. Most of the broken viable seeds of flax and amber sorghum were those which constituted more than half a normal seed. Broken seeds of alfalfa and sweet clover half or less in size possessed about half the viability of portions larger than one-half as measured by the weight of each group. From a five gram sample of sweet clover seed, 3.65 per cent consisted of broken seeds half or less than normal in size and 6.07 per cent consisted of broken seeds over half a normal seed. A total of 60 and 67 normal sprouts were obtained in sand from each of the two groups respectively. Present official methods of analysis do not always account for the seed value of certain broken seeds.

The index value (purity x germination) secured by a modified method of analysis was higher for samples of sorghum, flax, sweet clover and alfalfa containing 5 to 10 per cent broken seeds than by the official method. The modified method provides for a correction in purity based on the number of normal seedlings produced by broken seeds.

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A PRELIMINARY REPORT ON THE GERMINATION OF MUSTARD SEED

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Mustard seed has a natural predisposition to go into a dormant or inactive state in which the embryo is not responsive to conditions which ordinarily favor germination. The tendency to revert into secondary dormancy is most highly developed in the seeds of wild mustard (*Brassica arvensis*), but it is also present to varying degrees in those of domestic mustard (*Brassica nigra*) and must be considered when testing their viability in the laboratory. It has been observed that mustard seed sometimes fails to germinate satisfactorily by the standard method upon moist blotters at 20° C in darkness. In this paper the writer offers some practical suggestions for promoting the germination of mustard seed which fails to respond when tested by the usual method.

Freshly harvested mustard seeds are very sensitive to high temperature and some lots may fail to germinate completely at 20° C in darkness. Seed of this nature should either be placed at a temperature of 15° C or prechilled at 6° C for from three to five days and then transferred to the higher temperature. The germination of new crop seed at 20° C can also be remarkably promoted by placing it upon moist absorbent cotton in a daylight germinator. As an illustration of this, one sample of six-months-old Fordhook Fancy mustard seed, which germinated 15 per cent on moist blotters at 20° C in darkness, germinated 85 per cent when placed upon moist absorbent cotton in a daylight germinator. Mustard seeds which germinate satisfactorily at 20° C in darkness usually revert into dormancy at a temperature of 25° to 30° C, and the reversion into dormancy can be greatly reduced by exposure of the seed to light and the use of a very moist substratum. It has been found that many lots of new crop mustard seeds germinate much better at 20° C when placed upon blotters moistened with a 0.2 per cent solution of potassium nitrate. The nitrate is most effective in promoting germination at a temperature of 15° to 20° C in the light. It should be explained that potassium nitrate is not effective in promoting germination at 25° to 30° C and it may have a decided inhibitory effect on germination.

There is no optimum temperature for the germination of mustard seed of different ages. There are some new crop mustard seeds which germinate completely at temperatures of 6° to 15° C. On the other hand, there are other lots of seed of the same age which sometimes give a higher percentage of germination at 20° C than at 15° C or lower. The reversion of the seeds into dormancy at a low temperature is a factor to be considered when prechilling them in order to promote their germination at a higher temperature. It has been observed that the germination of some mustard seeds can be promoted by prechilling them at 6° C for three to five days, but if retained at the low temperature for twenty days they may fail to germinate when subsequently removed. In practice, it is not advisable to leave the seeds at the low temperature for more than ten days. These responses show that mustard seed may revert into dormancy at either a low temperature or at a high temperature.

The reversion of the seed into dormancy at the two extremes of temperature can be prevented by subjecting it to an alternating temperature, and apparently this is one of the reasons why an alternating temperature promotes germination.

Mustard seed may revert into dormancy when the metabolic processes are slowed down either by the use of unfavorable temperature or light relations for germination or by reducing the moisture content of the substratum. A partially dry substratum may have a detrimental influence on germination. The degree of dormancy which develops in the seed depends upon the period of time during which the metabolic processes are arrested. Mustard seeds which fail to germinate promptly at 20° C in darkness become more difficult to germinate if retained in darkness for several days. When repeating tests on light-sensitive seeds, it is advisable to use fresh seeds and to place them in a daylight germinator rather than transfer the dormant seed from darkness to light. It is possible, however, to promote the germination of dormant mustard seed by transferring it to light and especially by placing it upon a cotton substratum moistened with potassium nitrate. The dormant seed may also be germinated by placing it at a temperature of 6° C for several days or by drying at a temperature of 30° C for two to five days.

There is a general tendency for mustard seed to germinate more readily following a period of dry storage. There are some mustard seeds, however, that revert into a state of secondary dormancy while in dry storage and, although such seeds are viable, they are sometimes very difficult to germinate by the usual methods. A number of different lots of old mustard seeds failed to germinate readily upon moist blotters at 20° C. One lot, a sample of three-year-old Florida Broad Leaf mustard, which germinated 1 per cent on moist blotters at 20° C in darkness, germinated 69 per cent when placed upon cotton moistened with potassium nitrate in a daylight germinator (Table 1). In further tests this particular lot of seed germinated 50 per cent in soil at laboratory temperature and 89 per cent when sown in soil in the greenhouse.

TABLE 1.—*The germination of old secondary dormant mustard seeds under different laboratory conditions and in soil.*

Variety	Percentage germination			
	On cotton moistened with KNO_3 in a daylight germinator at 20° C	In closed germinator at 20° C		Seed sown in soil in greenhouse, 15° to 25° C
		On blotters	In soil	
Chinese.....	74	6	42	73
Florida Broad Leaf	69	1	50	89
Florida Broad Leaf	79	5	52	85
Fordhook Fancy...	82	8	38	77
Fordhook Fancy...	85	12	84	95
Ostrich Plume.....	51	15	7	60

The increased germination of the seed in the greenhouse is attributed to the favorable influence of the greater difference between the day and night temperatures which varied from 15° to 25° C. This type of dormancy, while not present in all lots of old mustard seed, is of frequent occurrence and seeds which fail to germinate in darkness should be retested upon moist cotton in a daylight germinator.

It is natural for new crop mustard seeds to be difficult to germinate and it is reasonable to assume that seed which fails to germinate satisfactorily in the fall will germinate readily several months later. It appears that it is legitimate to use any available methods such as the use of potassium nitrate, a moist absorbent substratum, or exposure to light in order to promote the germination of new crop seed. On the other hand, when using a moist substratum and potassium nitrate to promote the germination of old mustard seed, it is possible to obtain a germination which may be far in excess of the real value of the seed. It is believed that the germination of these old seeds in the field will vary, depending upon the moisture content of the soil at the time of sowing. The fact that mustard seed may be viable and yet sometimes germinate very poorly upon blotters and in soil should be recognized in making germination tests.

The methods outlined for promoting the germination of mustard seeds are also effective in increasing the germination of the seeds of other cruciferous plants. A number of different lots of cabbage seed which germinated from 41 to 48 per cent upon moist blotters in darkness, germinated approximately 60 per cent when duplicate lots of seed were retested upon cotton moistened with potassium nitrate in a daylight germinator. In like manner, the germination of turnip seed was increased from 50 to 78 per cent by a similar treatment.

It is very difficult to determine whether some seeds are dormant or are dead, and, their value may be misjudged unless they are retested under different conditions. The firm, fresh-appearing seeds which fail to germinate at 20°C in darkness should be retested in order to be certain that they are dead and not dormant.

SOME OBSERVATIONS ON THE DECLINE IN VIABILITY OF CHEWING'S FESCUE SEED (*FESTUCA RUBRA COMMUTATA*)[1]

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The frequent use of what is represented to be Chewing's Fescue, Chewing's New Zealand Fescue, or New Zealand Fescue, (*Festuca rubra* var. *commutata* (Gaud.) (F. *fallax* Thuill.), in lawn seeding mixtures together with increasing interest in its reported decline in viability led to the following preliminary study of the question. The present trend of thought seems to be that perhaps this kind of seed should not be blended into a mixture unless it can be used immediately, and especially so if the seed has to be carried over a year or more.

In this study which was made to ascertain the actual decline in germination of the seeds from commercial unmixed stock and special mixtures the series of seeds for the germination tests were taken directly from the purified pure seed portion from the samples, all of which had been stored under uniform conditions in the laboratory from the time they were received. Nothing was known, however, of the previous history or treatment of the seed stock.

[1]Approved by the Director of the New York State Agricultural Experiment Station as Journal Paper No. 149, June 16, 1936.

The germination tests were all conducted simultaneously and according to the "Rules for Seed Testing." Examination of the ungerminated seeds in each case showed them to be apparently dead and not dormant.

Table 1 shows the results of germination tests made on officially collected samples after approximately one year in storage. Here the percentage loss of viability ranged from 1.0 to 71.6 per cent. The percentages of relative decline compared favorably with those shown in Table 2.

TABLE 1.—*Loss in germination percentage on unmixed samples of Festuca rubra commutata over a 1 year period.*

Sample No.	Germination				Time between tests	% Loss*
	First tested	Per cent	May 1936 %	% difference		
20	Dec. 1934	53	19	—34	17 mos.	64.1
9	Dec. 1934	85	59	—26	17 mos.	30.5
14	Dec. 1934	86	50	—36	17 mos.	41.6
10	Jan. 1935	73	47	—26	16 mos.	35.5
15	Jan. 1935	74	42	—32	16 mos.	43.2
21	Jan. 1935	60	17	—43	16 mos.	71.6
11	Jan. 1935	72	46	—26	16 mos.	36.1
17	Feb. 1935	78	35	—43	15 mos.	55.1
13	Feb. 1935	74	44	—30	15 mos.	40.5
19	Feb. 1935	88	35	—53	15 mos.	60.2
18	Apr. 1935	76	33	—43	13 mos.	56.5
16	Apr. 1935	71	36	—35	13 mos.	49.2
4	Apr. 1935	96	92	— 4	13 mos.	4.1
1	Apr. 1935	90	93	+ 3	13 mos.	+3.3
5	May 1935	93	89	— 4	12 mos.	4.3
2	May 1935	96	95	— 1	12 mos.	1.0
6	May 1935	97	91	— 6	12 mos.	6.1
3	May 1935	94	92	— 2	12 mos.	2.1
7	June 1935	95	89	— 6	11 mos.	6.3
12	June 1935	72	44	—28	12 mos.	38.8
8	Apr. 1935	88	67	—21	13 mos.	23.8

*Per cent loss = $\frac{\text{Original germination} - \text{1936 germination}}{\text{Original germination}}$

In Table 2 the percentage of viability loss (germination) over approximately a two year period is shown. Samples represented in this table were of the ordinary service type, i. e., those sent in by seedsmen. It will be noted that the loss in viability ranged from 6.0 to as high as 69.0 per cent. There was not a consistent decline in all of the samples.

Table 3 shows similar results obtained from fescue seeds which were removed from the officially collected lawn seeding mixtures. These sets of seeds were tested twice by the same laboratory, first when the samples were received in 1935 and again in 1936 or approximately 1 year later. The first laboratory test is compared with the vendor's stated germination. Too much weight should not be placed on this first comparison as no check on the vendor's germination procedure could be made. The second and third tests, however, may be regarded as comparable since the two laboratory tests followed the same procedure. Made at approximately one year intervals, the decline ranged from 14.0 to 96.0 per cent the first year and from 3.2 to 85.0 per cent the second year, which also compares favorably with the results in Table 2 where unmixed seed samples were used.

TABLE 2.—*Results of germination tests on unmixed samples of Festuca rubra commutata seed of an age of approximately 2 to 3 years.*

Sample No.	Germination				Time between tests	% Loss*
	First tested	Per cent	May 1936 %	Loss %		
11	July 1933	85	55	30	34 mos.	35.2
3	Aug. 1933	38	9	29	33 mos.	25.9
1	Aug. 1933	83	78	5	33 mos.	6.0
9	Aug. 1933	83	54	29	33 mos.	34.3
7	Aug. 1933	90	60	30	33 mos.	33.3
13	Aug. 1933	88	56	32	33 mos.	36.3
6	Aug. 1933	87	60	27	33 mos.	31.0
14	Oct. 1933	81	45	36	31 mos.	44.4
16	Oct. 1933	80	40	40	31 mos.	50.0
4	Oct. 1933	93	68	25	31 mos.	26.8
18	Oct. 1933	85	38	47	31 mos.	55.2
2	Nov. 1933	77	57	20	30 mos.	25.9
8	Nov. 1933	90	60	30	30 mos.	33.3
19	Dec. 1933	84	34	50	29 mos.	59.5
10	Feb. 1934	92	60	32	27 mos.	34.7
12	Mar. 1934	93	60	33	26 mos.	35.4
17	Mar. 1934	74	34	40	26 mos.	54.0
20	Apr. 1934	71	22	49	25 mos.	69.0
5	June 1934	82	57	25	23 mos.	30.4
15	July 1934	70	38	32	21 mos.	45.7

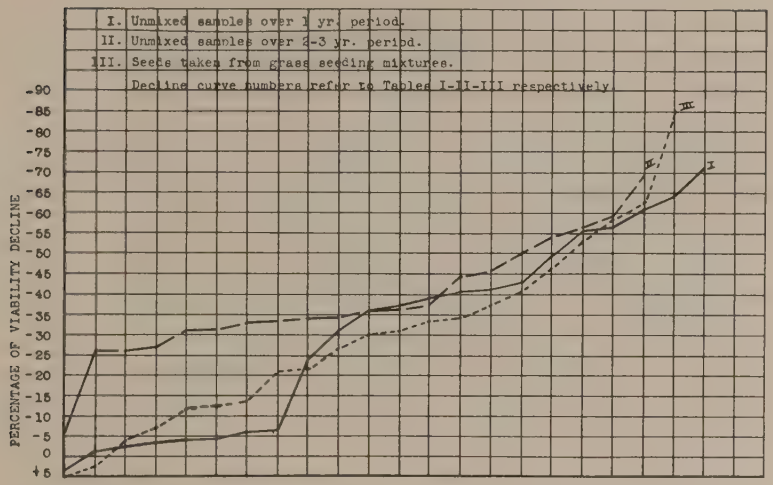
*Per cent loss = $\frac{\text{Original germination–1936 germination}}{\text{Original germination}}$

TABLE 3.—*Decline in germination of Festuca rubra commutata seeds taken from special seeding mixtures.*

Sample No.	Germination percentage		Time between vendor's and first laboratory test Months	May, 1936 laboratory test germination %	Time between laboratory tests, months	Loss in germination %
	a[1]	b[2]				
9	85	64	10	50	10	21.8
19	80	38	9	16	11	57.8
13	82	3	8	2	10	33.3
10	85	63	7	46	10	26.9
20	45	16	6	6	10	62.5
16	80	44	6	26	10	40.9
14	50	67	5	44	11	34.4
7	50	52	7	45	9	13.4
8	90	48	5	38	11	20.8
17	85	60	6	32	10	46.6
11	60	20	7	14	9	30.0
12	60	13	6	9	10	30.7
3	90	93	–	90	10	3.2
6	80	64	6	56	10	12.5
21	60	67	5	10	10	85.0
5	—	9	5	8	10	11.1
15	80	67	5	42	10	37.3
18	85	73	1	34	13	53.4
4	70	38	4	36	10	5.2
2	13	6	6	8	8	2.5
1	75	93	5	98	9	5.1

[1]Germination percentage guaranteed or stated by vendor.
[2]Germination percentage found by our tests approximately 6–8 months later.
[3]% loss in germination = $\frac{\text{First laboratory test—2nd laboratory test}}{\text{First laboratory test}}$

Figure I - Percentage Decline in Viability of Festuca rubra.



A graphic comparison of Tables 1, 2, and 3 is made in Figure 1. It will be noted that the percentage decline curves coincide fairly well between 25 and 65 per cent with the greatest similarity occurring between 55 and 60 per cent.

CONCLUSION

Since the decline in viability covered such a wide range no definite rule or formula could be devised to indicate the probable or expected decline in any given stock. It was interesting and highly significant to note that in some certain cases the vitality of the seed, even after 2 to 3 years, was approximately equal to that originally found. Other stocks, of course, had essentially passed out of the realm of practical planting usefulness.

In general the samples having the highest percentage of viable seeds the first year had a smaller decline the second year, while those showing low or weak viability at first decreased more rapidly. The decline seemed to bear a direct relation to the lapse of time.

In some cases where the seed stock had probably received unusually good treatment during harvest, shipment, and in storage the decline was practically nil, the results of the final tests being essentially equal to the original ones.

The longevity of *Festuca rubra commutata* seed in the lawn seeding mixture, then, is largely dependent upon the original quality of the seed actually used. This inherent quality one is unable to determine by a germination test alone. Every effort should be made to secure only that seed which presents high original germination results with strong, vigorous sprouts at the time of delivery and acceptance otherwise the fescue seed in certain cases may become practically worthless if the mixture into which it is blended is carried over the first year either by the buyer or the vendor.

THE GERMINATION OF LETTUCE SEED IN THE LABORATORY AND IN THE FIELD

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In a previous report before this association the writer pointed out that the germination of lettuce seed can sometimes be remarkably promoted by exposure of the moist seed to light. It was stated that the favorable influence derived from soaking lettuce seed in water is due to the action of light on the moist seed. It was recommended to test lettuce seed in a daylight germinator at a temperature of 15° to 20° C. The work with lettuce seed has been continued and it is the purpose of this paper to consider the prevalence of light-sensitive seed in different varieties of lettuce, and to record some further observations on their behavior in the laboratory and in the field.

The commission box packets of seed collected by the state inspectors provided several hundred samples of lettuce for experimental purposes. The lettuce seeds were tested upon blotters in a daylight germinator at a temperature of 15° to 20° C. This method gave a complete germination of all the viable seed. The question naturally arises: Is it necessary to test all commercial stocks of lettuce seed in a daylight germinator or even to give them a preliminary exposure to light? In order to answer this question the seeds were also tested at 20° C in darkness to determine the prevalence of light-sensitive seed in the different varieties. The results showed that the seeds of the Big Boston and the Grand Rapids varieties are more sensitive to light than those of the Black-Seeded Simpson and Prizehead varieties. The seeds of the Grand Rapids variety are the most sensitive to light, and of the seventy packets tested only five, or 7 per cent, germinated satisfactorily in darkness without exposure to light. It was found that all of the 45 samples of the Iceberg variety germinated completely in darkness. In the tests made with seeds of the Hanson, New York, and Romaine varieties it was found that 10 to 40 per cent of the samples needed an exposure to light in order to germinate satisfactorily in darkness. It should be explained that both light and temperature may limit the germination of lettuce seed at 20° C in darkness and both of these factors must be considered. In further tests it was found that most Big Boston seeds could be germinated in darkness by first prechilling them at 6° C for five days and then transferring the tests to a temperature of 20° C. On the other hand, when Grand Rapids seeds were prechilled for an equal length of time all of the most light-sensitive lots failed to germinate satisfactorily in darkness. In previous work (2) it was found that the seeds of all the different varieties of lettuce are sensitive to light when tested within a few months after harvest. The observations recorded here are based on commercial stocks of seed which were at least nine months old, and the results merely show that the seeds of some varieties remain sensitive to light longer than the seeds of other varieties.

In order for light to be effective in promoting the germination of lettuce seed they must be moist, but it is not necessary that they be surrounded by a film of water. In a series of tests dry lettuce seeds of the Grand Rapids variety were placed upon moist blotters and after five minutes were placed at

20° C in darkness to germinate. It was found that light sometimes has very little influence on the seeds during the first five minutes after they are wetted. On the other hand, when the seeds were first allowed to absorb water for two hours in darkness then a brief exposure to light for a minute or even less was effective in remarkably increasing the germination. If the seeds are retained in darkness for several days many of them will revert into a deeper state of dormancy and may fail to germinate satisfactorily when later transferred to light.

The sensitivity of lettuce seeds to light must also be considered when making germination tests in soil both in the laboratory and in the field. It was observed that Grand Rapids seeds which germinated 90 per cent on moist blotters in daylight failed to germinate more than 20 per cent when placed in muck soil and covered to a depth of one-fourth inch. It was possible, however, to obtain a complete germination in soil by first giving the moist seeds an exposure to light. The seeds were distributed upon the moist soil, but not covered, and exposed to light for three to four hours before covering them with soil. Grand Rapids seeds which were tested in this manner germinated 95 per cent in soil at 20° C in darkness, whereas, similar seeds which were placed in soil and covered at once germinated only 15 per cent. A failure to consider the light sensitivity of lettuce seeds may lead to erroneous conclusions regarding their vitality. It is evident that the person making the soil tests must be able to differentiate between the behavior of light-sensitive seeds and the response of old seeds of very low vitality.

The germination of lettuce seed in the field may be limited by both light and high temperature. It has been found that the failure of lettuce seeds of the Grand Rapids variety to germinate in muck soil in the field is due primarily to the exclusion of light by the dark soil. In a large number of tests Grand Rapids lettuce seeds which germinated 80 per cent or more in the laboratory failed to germinate more than 30 per cent in the field. It was possible to increase the field stand by presoaking the seed in cold water for two hours and giving the moist seed an exposure to light.

That light and not temperature limits the germination of Grand Rapids lettuce seeds is further supported by the data in Table 1. The results show

TABLE 1.—*Responses of Big Boston and Grand Rapids lettuce seeds to light and prechilling when placed to germinate at a temperature of 27° C in darkness.*

Seed received no treatment	Percentage germination when: Seed was presoaked in water at 20° C for 2 hours		Seed was prechilled at 4° C for 5 days	
	Not dried	Dried 24 hours	Not dried	Dried 24 hours
	Grand Rapids			
5	81	39	97	95
1	68	30	95	81
1	82	81	96	78
1	74	73	96	96
1	77	53	90	81
	Big Boston			
2	2	5	64	66
0	8	7	99	68
2	35	3	92	78
1	32	14	98	84
4	23	12	96	94

that a satisfactory germination of light-sensitive Grand Rapids seeds was secured at 27° C in darkness by presoaking the seeds in cold water for two hours.

Perhaps the most practical method to increase the field stand is to presoak the seed in cold water for three or four hours and either sow them moist or dry them until they will pass through a seeder. There are many lots of lettuce seeds which retain the non-dormant state when dried, while others, especially those of the Big Boston variety, revert into dormancy when dried. The seeds have a greater tendency to revert into dormancy when dried while exposed to light, hence it is advisable to dry them in darkness. This treatment may fail to increase the field germination if the soil is dry at the time of sowing. If the soil does not contain sufficient moisture for the seed to germinate promptly, they may revert into dormancy and fail to germinate.

Vegetable growers in the southern states sometimes have difficulty in getting new crop lettuce seed to germinate. The failure in getting new crop lettuce seed to germinate is unquestionably due to the high temperature. Borthwick and Robbins (1)[1] have shown that lettuce seed can be germinated at a high temperature of 30° C provided the growth processes are started at a lower temperature. The favorable influence of low temperature on the germination of lettuce seeds is shown by the data in Table 1. In this series of tests a number of duplicate lots of lettuce seeds were distributed upon moist blotters and after giving them an exposure to light for one hour they were placed at a temperature of 4° C for five days. In one of these series the prechilled seeds were transferred to a temperature of 27° C in darkness to complete germination, while the duplicate series was first dried at laboratory temperature for 24 hours. This low temperature treatment was especially favorable for the germination of the seeds of the Big Boston variety which are very sensitive to high temperatures. The results also show that the treated seeds may be dried for twenty-four hours and retain the non-dormant state. The seeds of the Grand Rapids variety which are limited in their germination by light and are quite temperature tolerant failed to show as great an increase in germination following the low temperature treatment. The germination of a number of different lots of Grand Rapids lettuce seeds was increased from 1 to 70 per cent merely by presoaking the seed in water at 20° C for two hours, whereas, a similar treatment had much less influence on Big Boston seed. This difference in the sensitivity of the seeds of these two varieties of lettuce to light and temperature should be considered in treating them prior to sowing in the field. The seeds of most of the varieties of lettuce are sensitive to temperature and should be given the low temperature treatment, especially if it is necessary to dry them before sowing. The person handling the seeds should understand their nature and vary the treatment depending upon the seed and the facilities available.

When testing lettuce seed in the laboratory, it is recommended to make the germination tests in a daylight germinator at a temperature of 15° to 20° C. If a daylight germinator is not available the seeds should be placed upon wet blotters for three to four hours and given an exposure to light before placing them in a closed germinator. In making tests in soil the seeds should likewise be given an exposure to light for several hours before they are covered. The new crop seeds which fail to germinate on blotters at 20° C in a daylight germinator should be placed upon wet cotton. A very moist substratum is favorable for the germination of lettuce seed and appears to promote germination by counteracting the unfavorable influence of high temperature.

[1]Numbers in parenthesis refer to Literature Cited.

Lettuce seeds change while in storage without any apparent decrease in vitality and there is a corresponding change in the most favorable conditions for their germination. It has been observed that Grand Rapids lettuce seeds may be very sensitive to light when first received at the laboratory but may germinate completely in darkness when tested a year later. New crop lettuce seeds are also sensitive to high temperature and as they age become capable of germinating at higher temperatures up to approximately 25° C. The decrease in sensitivity to temperature may account for the belief among vegetable growers that old lettuce seed is better for planting than fresh seed.

The change in the sensitivity of lettuce and other seeds to light while in storage may account for the statements sometimes made that seeds that have lost their vitality later become germinable. The erratic behavior of lettuce seeds is not due to a variation in their vitality, but to a change in their physiological state which necessitates different germinative conditions.

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SPECIAL EQUIPMENT FOR GERMINATING CORN AND SOY BEANS

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The detection of fungi which cause dry rots of corn by an examination of germinating kernels on farmers' samples of corn has been rendered as a service by the plant pathology staff of Iowa State College since 1922. Beginning in 1930 this service became a definite part of the routine analytical work of the college seed laboratory. The rag-doll and the modified rag-doll were first used to make the tests, both of which were soon replaced by trays two feet square and two inches deep partially filled with sand or sawdust and covered with glass. The kernels were placed on the substratum in rows so that no two kernels were in contact, a requirement for the accurate detection of the percentage of kernels infected with pathogens. The importance of dry rot diseases in Iowa has made it necessary to give careful attention to the seed that is planted. Methods of germination must be such that fungi can be detected.

The production and certification of hybrid seed corn in the state has been steadily increasing. A part of the certification requirements is a germination of 90 per cent or more, hence all samples for which certification is requested are tested for germination in the seed laboratory and for the presence of those diseases which reduce germination.

The use of sand or sawdust trays is practical only for a small number of samples or for demonstration purposes. Fresh material must be supplied or the used material sterilized. It became necessary, therefore, to design a different type of tray. The first attempt resulted in galvanized iron trays 18 x 22 x 1½ inches with a lip on three sides near the top so that a thin cover could slide on or be quickly removed. A copper, fine-mesh screen was soldered to a frame

of copper of such dimensions and construction that it could rest on the bottom of the tray with the wire screen about ½ to ¼ inch above the bottom. A blotter placed on top of the screen with one end long enough to be in contact with water in the bottom of the tray makes a satisfactory substratum. The kernels are placed on the blotter, 400 per tray, by means of a counter made of press board with 100 holes and equipped with a copper bottom which slides in or out in a groove. Figure 1 illustrates the counter described. This particular type of counter is convenient in that it can be first filled, then placed on any tray desired. Samples of corn placed on a tray as described above and held in the germinator for four or five days at 25° to 28° C can be read and the report mailed to the sender.

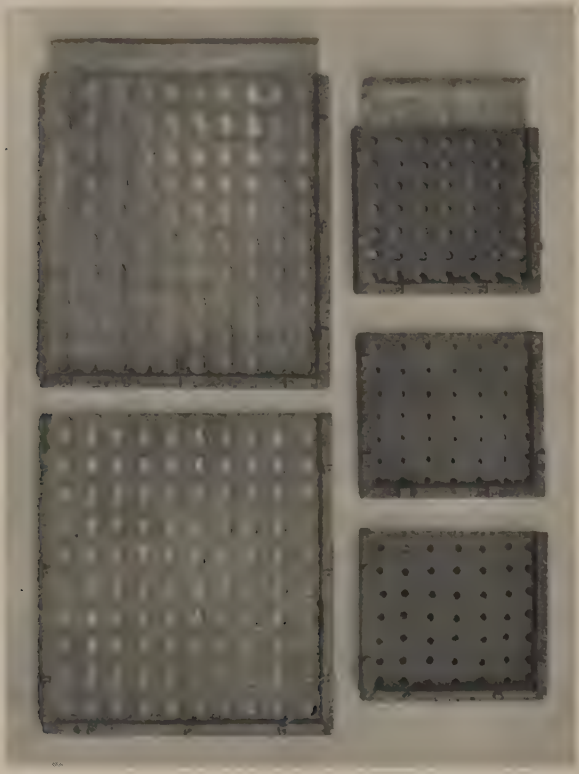

FIGURE 1. SEED COUNTERS FOR SOY BEANS AND CORN.

In October, 1935, it became evident that a serious seed corn situation had arisen in the state because of excessive rains and low temperatures in May and June which delayed planting and shortened the growing season, followed by early killing frosts and favorable moisture and temperature conditions in October for the development of dry rot fungi. The need for in-

creased facilities for testing corn became evident. Plans were made to meet the situation. A large ice box 2½ x 5 x 5 feet which had been used for the storage of seeds and pure cultures of fungi was remodeled by installing upright boards inside, to which guides, 2½ inches apart, for trays were fastened by screws. Space for 54 trays 18 x 24 inches was thus made available.

The type of tray finally constructed is made of galvanized iron 18 x 24 x 1½ inches in size. A narrow guide ¼ inch wide and ⅜ inch below the top of the tray was constructed on the inside and on both sides and ends, which serves as a rest for the copper screen wire soldered into a frame. The frame rests on the guides and a blotter can be placed on the copper screen. Moisture is maintained in the blotter by three cottonwool wicks which extend the full length of screen and each end dips into the layer of water below.

The temperature control consists of an electric thermostat installed on the upper inside wall of the germinator together with a heating unit placed just above the humidity pan which is kept full of water. It was anticipated that the temperature would be somewhat uneven and in the first trials the difference in temperature between the top and bottom trays was 7° C. Later a small "Baby Conoidal" Exhaust fan was installed outside and on top of the germinator. An iron pipe was extended from the fan inside to the bottom of the germinator and several half-inch holes were bored through the top for the intake of air. The fan withdrew excess carbon dioxide and at the same time provided for a circulation of air and reduced the temperature difference above and below to nearly four degrees. Since corn is not particularly sensitive to temperatures between 18° and 32° C the difference of 4° C was not considered as serious. The adjusted temperature of the germinator for service testing is 24°–28° C.

In practice four 100 kernel samples are placed on each tray and as a result of the observations made by Davis and Porter (2)[1] all corn kernels are placed with the embryo next to the blotter. Within three days the germination of corn in the upper trays can be read, although four days are preferred. If necessary, two sets of tests can be made in seven or eight days. Germination on the lower trays is slower than on the upper because of lower temperature, and lower humidity. Soil boxes for the testing of irregular shaped kernels of inbreds or hybrids and of pop corn are placed on the lower trays. The total capacity of the germinator is 216 samples of 100 kernels each or 54 samples of 400 kernels each. The latter number is used for all labeling requirements of vendors.

The acreage of soy beans has increased tremendously in Iowa within recent years. Increased demand for soy bean seed has been reflected by the large number of samples sent to the seed laboratory. A comparison of the results secured by testing beans in paper or cloth-dolls, between blotters and in soil has been made. The complete data have not been tabulated but the results show that the response in soil is most reliable. Copper boxes 6 x 12 x 1½ inches are now used. In each half of the box 50 seeds are placed by means of a seed counter as illustrated in figure 1. One extra seed must be added each time because the counter has 49 holes. The soil used consists of equal parts of screened sand and compost autoclaved in the greenhouse and brought to the laboratory. The beans are covered with a half-inch layer of soil. The boxes are placed on trays made to fit in an old oak cabinet 32 x 51 x 30 inches, which was remodeled and insulated. Temperature control is accomplished in

[1]Numbers in parenthesis refer to Literature Cited.

the same manner as for the corn germinator described above. The temperature maintained is about 30° C although Edwards (1) has shown that a temperature of 33°–36.5° C is most favorable for germination of Black Eyebrow soy beans.

Watering of the soil in which soy beans are planted is important. The soil can be kept reasonably dry and the final germination is accurate, but germination is often uneven. It has been found that a thorough wetting of the soil for the first 24 to 48 hours is preferable until the beans absorb adequate moisture. The result is a more uniform germination. To determine hard seeds and certain abnormal sprouts it is necessary to dig in the soil with tweezers after the emerged seedlings have been removed. A test by the methods described may be completed in four or five days.

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FURTHER STUDIES WITH THE GERMINATION OF CRESTED WHEAT GRASS[1]

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The Seed Analyst is constantly confronted with new problems in seed germination as new varieties and species of seeds are brought into commercial prominence. While in the majority of cases seeds of close botanical relationship can be successfully germinated by the same methods, it sometimes happens that different species of the same genus may require somewhat different treatment if satisfactory results are to be obtained.

Crested wheat grass (*Agropyron cristatum*) has offered such a problem. Although slender wheat grass (*Agropyron pauciflorum*), a species which has been in commercial use for many years, is successfully germinated between blotters at an alternating temperature of 20°–30° C crested wheat grass requires temperatures below 20° C for at least a part of the germinating period if correct results are to be secured from all tests. This is particularly true when tests are made within the first few months after seed is harvested.

MATERIAL AND METHODS

In continuation of the work previously reported[2], 166 lots of commercial crested wheat grass and 4 lots of hand harvested seed of the 1935 crop were tested in whole or in part by the following methods:

1. Between blotters at alternating temperatures of 20° C for 18 hours and 30° C for 6 hours.

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[1]Contribution from Montana State College, Agricultural Experiment Station. Paper No. 74, Journal Series.

[2]Hay, W. D. Germination of crested wheat grass (Agropyron cristatum): Preliminary studies. Proc. Assn. Off. Seed Anal. N. America. *1935*: 66–70. 1936.

———. Germination of crested wheat grass and slender wheat grass. *News Letter* Assn. Off. Seed Anal. N. America. *10*, 1:3. 1936.

2. Between blotters at constant temperature of 14°–17° C.
3. Between blotters, prechilled for 6 days at 8°–10° C., completed at a constant temperature of 20°–22° C.
4. Between blotters, prechilled for 5 days at 8°–10° C., completed at a constant temperature of 20°–22° C.
5. Between blotters, prechilled for 4 days at 8°–10° C., completed at a constant temperature of 20°–22° C.
6. Between paper towels at a constant temperature of 20°–22° C.
7. Between paper towels at a constant temperature of 14°–17° C.
8. Top of blotters light germinator at a constant temperature of 20°–22° C.
9. Top of blotters light germinator at a constant temperature of 15°–18° C.
10. Soil of half sand, half loam at a constant temperature of 20°–22° C.
11. Soil of half sand, half loam for 8 days at a constant temperature of 14°–17° C completed at an alternating temperature of 20°–30° C.

All tests were run for a period of 21 days. It was determined, however, that little germination occurred after 12 to 14 days in tests run by the two methods which proved satisfactory in this investigation.

Whether the seeds were hand threshed or commercially harvested had no effect upon the germination except that in a few instances excessive breakage lowered the germination of the commercially harvested lots.

DISCUSSION

Two of the methods used produced satisfactory results in all tests. These were; (A) between blotters at 14°–17° C, and (B) between blotters prechilled 6 days at 8°–10° C, completed at 20°–22° C. Tests that were prechilled 5 days gave satisfactory results with all but 2 lots, while those prechilled for only 4 days were unsatisfactory in several instances.

Paper towels at 14°–17° C and top of blotters in the light germinator at 15°–18° C gave satisfactory results in nearly all tests, but the tests between blotters were preferred because they were easier to handle from the standpoint of counting, shifting of samples and moisture control. Tests made in paper towels at 20°–22° C and on top of blotters in the light germinator at 20°–22° C gave decidedly inferior results with many lots.

The necessity for maintaining temperatures below 20° C was also demonstrated with the tests run in soil consisting of half sand and half loam. The tests made in soil during the month of September at 20°–22° C gave a mean germination of 58 per cent as against 90 per cent for tests on the same lots at 14°–17° C for 8 days and completed at 20°–30° C.

Tests made between blotters at the customary alternating temperatures of 20°–30° C gave a low mean germination during September but as the season advanced results from this method more closely approximated those of the satisfactory methods.

Retests of the hand threshed samples indicated that the necessity for low temperatures was not so pronounced in December as in September and had practically disappeared by May of the following year.

CONCLUSIONS

Temperatures below 20° C were found necessary for at least a part of the germination period if satisfactory results were to be secured in testing all lots of crested wheat grass the first few months after harvest.

The necessity for the colder temperatures became less marked as the seed remained in storage.

Successful germination was secured from the tests conducted between blotters at 14°–17° C and those prechilled 6 days between blotters at 8°–10° C with the tests completed at 20°–22° C.

TABLE 1.—*Germination of crested wheat grass from the 1935 crop.*

Method of testing[1]	Month tested and percentage of germination								
	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May[2]
B 20°–30° C	64	82	81	85	87	87	87	86	89
B 14°–17° C	93	92	89	90	89	92	91	92	90
Prechill 6 da	93	91	—	—	—	—	—	—	—
Prechill 5 da	92	—	—	—	—	—	—	—	—
Prechill 4 da	90	—	—	—	—	—	—	—	—
P. T. 20°–22° C	78	—	—	—	—	—	—	—	—
P. T. 14°–17° C	93	—	—	—	—	—	—	—	—
Light 20°–22° C	73	—	—	—	—	—	—	—	—
Light 15°–18° C	85	—	—	—	—	—	—	—	—
Soil 20°–22° C	58	—	—	—	—	—	—	—	—
Soil 14°–17° C, 8 da. finish 20°–30° C	90	—	—	—	—	—	—	—	—
Number lots tested	34	23	43	14	20	16	10	10	4

[1]Detailed explanation of testing methods given page 86.
[2]Retest of hand threshed lots.

PROCEDURE USED IN AN ANALYTICAL AND MYCOLOGICAL STUDY OF SEED WHEAT

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The planting value of a seedstock is its ability to return a profit to the grower and is determined largely by the pounds of pure seed produced per acre less the dockage due to weed seeds, other crop seeds, and disease organisms. The seed analyst attempts to determine this producing capacity of the seedstock and, to some extent, the competitive ability of the weed and other crop seeds. An accurate appraisal of a seedstock such as winter wheat, however, cannot be derived safely from the analytical data usually reported to the farmer. The principal factors required for an evaluation of wheat seed are purity, germination, bushel weight, varietal specificity, local adaptation or winter hardiness, competitive weed seeds, competitive crop seeds, and disease organisms. Admittedly, several of these factors are usually neglected. While it is possible, and perhaps advisable, for the farmer to obtain this information elsewhere, many welcome such data in the analyst's report.

During the summer and autumn of 1935 wheat was collected directly from drills and later studied with considerable thoroughness. Interviews with the farmers revealed plainly that many had no definite knowledge of the viability of the seeds, of the extent of weeds and other crop seeds, and laboratory examinations did not substantiate their statements concerning varieties and disease. A procedure was therefore developed to facilitate the determination of all the factors considered important in an appraisal of wheat for seeding purposes.

The samples were taken from the seeder boxes and placed in paper bags which were numbered, brought to the laboratory, and arranged consecutively. The bags, containing four samples, were opened, a 15-gram portion removed from each with a flamed spoon, and dropped into flasks of distilled water. While the adherent fungous spores were loosening from the seeds the remainders of the samples were analyzed. The entire bulk of a collection, usually two pounds, was poured onto a sieve and the smaller weed seeds removed by gravity. Unbroken balls of stinking smut, Fusarium discolored seeds, ergots, and seeds of all noxious weeds were counted from the undivided bulks. Two determinations were made for bushel weight and the samples were then divided to produce two 50-gram representations for the usual analytical studies. Not only the weight, but the nature of the inert matter was observed so that the drilling disadvantages could be reported. The number of each species of weed seeds was determined and later computed on the usual pound basis. In many samples the cockle, chess, and quack grass seeds were weighed and the percentage figures reported as well as the number per pound.

Similar determinations were made for the other crop seeds. Particular attention was paid to seeds of winter-hardy plants, such as winter vetch and rye, since these produce seedlings which compete with the wheat plants. Seeds of the frost-intolerant plants, such as oats, barley, and buckwheat,

were counted, but their presence was not considered important. In fact, under normal weather conditions in New York State, they offer a minimum of competition to the wheat seedlings.

Only 35 per cent of the farmers interviewed reported that their wheat was of a definite variety. During the purity analyses of the samples percentages of white and red wheat were computed and, to some extent, the percentages of definite varieties. Although the separations between various white and between red varieties could not be made accurately, the occurence of red seeds in white varieties, and *vice versa*, proved that many farmers had allowed their strains to become mixed.

Both shrivelled and sprouted seeds were common in the 1935 seedstocks. Their number per pound or percentage by number or weight was ascertained for each sample. The shrivelled seeds were examined critically for symptoms of scab and in several instances were removed for more complete mycological studies. At least 100 shrivelled and sprouted seeds were counted out for germination tests.

When the analytical studies were completed, the flasks were agitated vigorously and the aqueous suspensions of spores poured into centrifuge tubes. Concentration of the spores was accomplished by a three to five minute operation of the centrifuge at 2100 R.P.M. The supernatant liquid was extracted from each until exactly 2 cubic centimeters remained. The concentrates were then disturbed by shaking and removed by pipettes of small bore. One drop, or 0.01 cubic centimeter, was delivered onto a clean glass slide and covered with a thin glass slip. The drops were examined under the microscope. In all cases the fungus species present in the suspensions were recorded, and in some cases, the number of spores were determined and computed on the basis of thousands per pound of seed. The spores of the smut organisms, *Tilletia levis* and *T. tritici*, were given particular attention since these fungi have been reported repeatedly in New York fields.

Germination studies were made both in the laboratory and in the greenhouse. At least two lots of 100 unselected seeds were germinated in folded towels at 20°C. The results recorded included dead seeds, weak seedlings, strong seedlings, root rots occasioned by various fungi, and stunted seedlings attributed to chemical or heat seed treatments. The sprouted seeds found in several samples also were germinated in towels and the resultant seedlings and percentages of germination compared to those of the unselected seeds. The shrivelled seeds were placed to germinate under similar conditions and observed especially for weak seedlings and fungous growths and lesions. Discolored portions of the coleoptiles and roots were surface sterilized in a seven per cent aqueous filtrate of calcium hypochlorite ($CaOCl_2$) and plated out on agar surfaces. The resultant fungous growths later were examined and identified.

Soil germination tests were conducted to determine the seedling emergence and vigor from unselected, large, small and shrivelled seeds. Both sand and pasteurized soils were used for substrates. The seeds from each sample were placed in adjacent rows so that accurate comparisons could be obtained. Percentages of emergence were determined ten days after planting and when the seedlings were from 25 to 40 days old the tops were cut off and weighed. These data were then compared to the original weights of each 100 seed lots and the ratios of green weight of tops to dry weight of seeds computed. A comparative idea of the size of the seedlings from the large, unselected, small, and shrivelled seeds may be obtained from figure 1.

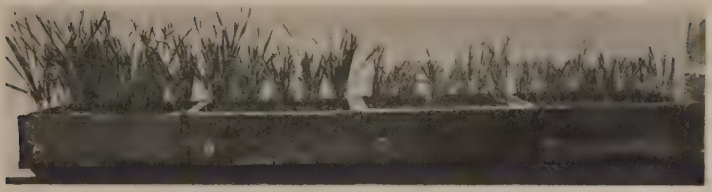

FIG. 1.—SOIL GERMINATION AND SEEDLING DEVELOPMENT OF SELECTED WHEAT SEEDS.

A, seedlings from large plump seeds; B, seedlings from sample-run seeds; C, seedlings from small plump seeds; D, seedlings from shrivelled lightweight seeds.

A complete report of the results of studies based on two years' drill collections of seed wheat will be made in a later publication. Suffice it to say, that the seed stocks varied greatly in their planting value, about 5 per cent being utterly unfit for seeding purposes, another 5 per cent being very admirably prepared for production of pure stands of wheat, and the majority being average value farmer-cleaned wheat. A copy of a representative report appears in Table 1.

TABLE 1.—*Report of a typical drill-survey seedstock.*

Purity analysis	Per cent	Weed seeds	Per pound
Pure seed	99.39	Cockle	135
Weed seeds	.36	Chess	14
Crop seeds	.12	Quack grass	5
Inert matter	.13	Dock, curled	1
		Cress, field	4
Variety			
Forward (red)	98.50	Other crop seeds	
White wheats	.89	Winter vetch	5
		Oats	14
Germination in laboratory		Barley	3
Unselected seeds	97.	Rye	3
Sprouted seeds	72.		
Shrivelled seeds	89.	Disease organisms	
		Smut balls	27
Germination in soil		Ergots (barley)	2
Unselected seeds	96.	Scabby seeds	trace
Large seeds	97.	Fungus spores, thousands per lb.	
Small seeds	96.	Alternaria	97
Shrivelled seeds	85.	Stinking smut	4550
		Loose smut	575
Bushel weight	55.8 lbs.	Rust, uredo	85
		Fusarium	239
		Alternaria root-rot in 2 per cent of seedlings	

TOXIC EFFECT OF CERTAIN SEED TREATMENTS AS REVEALED IN GERMINATION RESPONSE

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As the result of an effort to put into commercial practice the findings of investigators with reference to the use of various dusts, liquids and other forms of seed treatment compounds there have appeared on the market commercial seed stocks in several forms treated with quite a wide variety of the various sterilizants or protective coverings. It is often necessary to submit these treated seeds to a germination test. As would be expected the germination response often depends upon the nature of the seed treatment used. Frequently it is possible to discover what kind of treatment has been employed by the appearance, odor or color of the treated seeds.

We have found that in some cases the efficiency of these compounds as preventatives of plant disease on or within the seed or soil have been determined by testing the seeds in soil in the field. When we undertake to germinate these dusted, dipped or otherwise treated seeds in the germinator the experienced worker notes various forms or degrees of seedling abnormality apparently due to poisoning from the compound used. These abnormalities or effects of poisoning usually take the form of thick stubby roots, some times thickening of the stem, or even a failure to form roots at all. Probably the seeds of the Cucurbits exhibit the most marked abnormalities. Crosier and others have called attention to these abnormal germinations due to effects of time upon treated grain. Lapse of time is not necessary with certain compounds to cause the poisoning effect since seed freshly treated with certain compounds, more particularly red copper oxide, may show the effect of poisoning which begins when the treated seeds are placed upon blotters to germinate, yet these same treated seeds do not show this condition when germinated in soil in the presence of organic matter which competes for the copper.

Abnormalities of seedling structure are not the only forms in which one encounters the effect of these seed treatments when making germination tests particularly those which leave some coating or covering about the seeds. Slow or erratic germination may take place thru failure of the seed to take up water because of the coating. Cabbage seed coated with zinc oxide is an excellent example of this condition. This season samples of garden peas taken from stocks treated with red copper oxide and graphite, or graphite alone, have come for germination test. These stocks may show slow or slackened germination and it seems to depend upon the variety of peas and the amount of covering still adhering.

It is to be expected that as the use of these seed treatments become more widely used in the seed trade analysts will encounter this problem of germinating treated seed.

RELATION OF SEED DISINFECTANTS TO SEED ANALYSIS[1]

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One of the most important functions of a seed laboratory is to determine as accurately as possible the value of a given seed lot for sowing. The term "value" has been used primarily to include the purity and viability of the sample in question. More recently, the importance of determining the presence of seed borne pathogens capable of causing crop losses by disease has been emphasized. Munn (7)[3] in 1919 mentioned the importance of detecting the celery blight organism; Porter (9) in 1931 presented a paper at the Seed Analysts' meeting at Toronto, Canada, listing some of the pathological work with seeds conducted by the Iowa laboratory, and again in 1932 in a paper read at the Seed Analysts' meeting at Fargo, N. D., the same author (10) gave specific methods for the detection of those organisms which cause certain cereal smuts, scab of small grains, stripe and spot blotch of barley, two kernel smuts of sorghum, kernel smut of millet, dry rots of corn and the yellow dwarf virus of onions. In the last mentioned paper it was stated that all tests of seed corn in the Iowa State College Seed Laboratory include both treated and untreated seed, with the result that the sender received a report showing what benefit to germination he might expect from the practice of seed treatment. These methods, as employed by the Iowa laboratory, illustrated the responsibility of the seed analyst in furnishing information for disease control. Orton (8) has prepared a list of seed borne pathogens and Crosier (2) recently listed a number of pathogens which have been detected in seed and stressed the joint responsibility of the seed analyst and plant pathologist for the control of plant diseases.

The commercial development of dust disinfectants for the control of cereal and other crop diseases and the more extensive use of such materials by farmers not only afford an added opportunity to seed analysts to prescribe control measures but also make it possible in many instances to determine in the laboratory the probable value of seed disinfection. The latter statement applies in particular to treatment of non-systemic pathogens which cause seedling blights and reduce field stands. In this group fall such diseases as Gibberella, Basisporium, Diplodia and Fusarium dry rots of corn, scab of cereals, spot blotch of barley and certain diseases of peas, tomatoes and cabbage. Certain systemic seed borne pathogens such as many of the smuts can also be detected and recommendations for control given. Davis (3) has used a haemocytometer for detecting spore load in samples of oats.

Prior to the general use of seed disinfectants in a seed laboratory it is desirable to determine the correlation of any effect of disinfectants on seed germination in the laboratory with that in the field. The effect of the treatment on the subsequent yield of the crop must also be considered.

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[1]Journal Paper No. J376 of the Iowa Agricultural Experiment Station. Project No. 427.
[2]Grateful acknowledgment is extended to W. E. Hendershott who aided materially in the collection of much of the laboratory and field data dealing with germination.
[3]Numbers in parenthesis refer to Literature Cited.

LABORATORY AND FIELD RESPONSE OF TREATED AND UNTREATED SEED

The effect of seed disinfectants on the germination of corn infected with the dry rot organisms, *Diplodia zeae*, *Gibberella saubinetii* and *Basisporium gallarum*, has been determined by Melhus et. al. (6), Raleigh (13) and others. Significant increases in field stand have usually resulted in significant gains in yield. Treatment of nearly disease free seed has seldom resulted in significant gains in either stand or yield. The condition of farmers' stocks of seed corn and the results of treating such seed have received relatively little attention. Tests made in Iowa in 1922 and 1923 indicated that *Diplodia zeae* reduced the viability of seed corn about 14 per cent. Comparative yield tests for five years between nearly disease-free and farmers' seed corn gave a difference of five bushels per acre in favor of the nearly disease free seed. Data from field plots (12) covering a period of nine years show an average gain of four bushels per acre from dust treatment of farmers' seed corn. Increases in stand resulting from seed treatment have ranged from none to 50 per cent. The average gain in stand for different seasons has been between five and eight per cent, although stand counts have not always been made in field plots.

A study of farmers' samples of seed corn has been made by the Iowa State College Seed Laboratory since 1929. The number of samples examined has varied from year to year, the largest number having been received in 1935–36, when nearly 6,000 samples were tested. In 1933, 40 samples of seed corn were obtained from some of the remnant lots used in the state yield test. These samples represented high quality seed corn, mostly ear tested and carefully selected. Laboratory tests on blotters were made with treated and untreated seed; each lot was then planted in the field in 10 replications using a restricted random arrangement. Both stand and yield were determined and the results are shown in Table 1. The differences in laboratory germination between treated and untreated seed, though small, are highly significant as shown by statistical analysis made by Hendershott (4). Yield differences are not sig-

TABLE 1.—*Effect of seed treatment on farmers' samples of corn tested in the laboratory and field, Ames, Iowa.*

Year	Percentage germination and yield					
	Treated					
	Number samples	Strong	Weak	Diseased	Field stand	Yield, bu. per acre
1933	40	92.7	4.7	0.6	66.8	40.3
1934	47	95.8	2.1	2.4	—	—
1934	40	98.2	0.8	1.1	68.6	60.4
1935	471	89.6	3.4	18.0	—	—
	Untreated					
	Number samples	Strong	Weak	Diseased	Field stand	Yield, bu. per acre
1933	40	90.3	6.7	3.5	65.8	39.9
1934	47	85.6	11.2	12.5	—	—
1934	40	92.3	5.2	10.6	67.1	57.5
1935	471	83.9	5.8	65.7	—	—

nificant, due, no doubt, to the high quality of seed used and to favorable growing conditions for corn at the time of planting.

Farmers' samples received by the laboratory in 1934 were poorer than the 1933 lots referred to above. Data on performance in the laboratory of treated and untreated lots from 47 samples are shown in Table 1. In addition, 40 similar samples were included in both laboratory and field experiments. Laboratory tests with both treated and untreated seed were made, after which half of the samples were planted in one plot and half in the other. The same method of planting was used as described for the 1933 plot. Stand and yield were determined and although the season was exceedingly dry, significant differences in yield were obtained. The average percentage increase in stand for the 40 lots was 1.5 per cent, which was not significant, and the gain in yield was 2.9 bushels per acre. The increase in laboratory germination as a result of seed treatment was 5.9 per cent. Differences in yield and in laboratory germination due to seed treatment were shown to be significant. The results are presented in Table 1.

In 1935, a seed corn shortage resulting from the drouth of 1934 made it necessary for the Emergency Relief Administration to collect seed from cribs of corn that was produced in 1933, a season exceptionally long and favorable for the maturity of corn. Graded, shelled samples were taken from 13 cribs, and both treated and untreated lots were tested in the laboratory. The average percentage infection with *Diplodia zeae* and *Fusarium* spp. was 6.8, indicating high quality seed. Average percentages of strong germination for treated and untreated seed were 93.8 and 90.8 respectively. The difference, though small, is significant, treatment having increased the percentage of germination in all but one lot.

Tests with treated and untreated seed from 471 samples of 1935 corn gave the results shown in Table 1. The effect of treating seed corn infected with *Diplodia zeae* as shown by laboratory germination is illustrated in Fig. 1.

FIGURE 1. EFFECT OF SEED TREATMENT ON DIPLODIA INFECTED SEED CORN

The effect of ethyl mercury phosphate on the laboratory and field germination of barley seed infected with *Gibberella saubinetii*, *Fusarium* spp. and *Helminthosporium sativum* has been determined by Porter (11) (Fig. 2).

FIGURE 2. EFFECT OF ETHYL MERCURY PHOSPHATE ON SCABBY BARLEY. LEFT—CHECK; RIGHT—TREATED

Close correlation was found between laboratory and field performance for both treated and untreated lots. Seed benefited by treatment in the laboratory was likewise benefited in the field. Similar results have been obtained with wheat. Five samples of untreated wheat and of duplicate samples treated Ceresan (1.5 per cent ethyl mercury chloride) were tested in autoclaved soil in the laboratory in 1933. Field plantings were made in five replications according to a Latin square arrangement. The results are shown in Table 2.

TABLE 2.—*Effect of seed treatments on farmers' samples of wheat, oats and flax in the laboratory and field, Ames, Iowa, 1933.*

Kind of seed	No. samples	Germination %								
		Treated				Untreated				
		Strong	Weak	Seedling blight	Field stand	Strong	Weak	Seedling blight	Per cent scab	Field stand
Wheat	5	83.8	2.5	0.1	84.9	71.5	5.4	6.0	11.8	76.0
Oats . .	19	86.7	5.1	—	78.2	82.4	7.5	—	5.0	74.0
Flax . .	19	65.7	5.7	—	53.8	61.0	6.0	—	—	47.0

In 1933 tests were made with 19 samples of oats in the same manner as described for wheat. These results also are given in Table 2. All differences in favor of treated wheat and oats were shown to be statistically significant.

Data obtained on the value of treating flax seed are less convincing than for wheat and barley. Reddy and Burnett (14) have published data on the effect of seed treatment on yields of flax. In general they have found that

early planted flax is benefited more by seed treatment than is late planted seed. Data obtained by the seed laboratory in 1933 on 19 farmers' samples of flax are shown in Table 2. Field plantings were made on April 8 with five replications of each sample.

Laboratory and field germination tests were made in 1933 with treated and untreated pea seed of the variety, Perfection. The samples were secured from a canning company in Iowa. Two plantings were made, one early in April, the other early in May, using 100 seeds per rod row with eight replications. The results are shown in table 3.

TABLE 3.—*Effect of seed treatments on field stand of peas at Ames, Iowa, 1933.*

Treatment	Percentage field stand		
	First planting	Second planting	Average of two plantings
Check	66	75.6	70.8
$HgCl_2$	64	72.5	68.3
Semesan Jr.	83.5	80.8	82.1
Sterocide	75.4	78.6	77.0
Barbak	60.1	73.2	71.7
Ceresan	79.0	82.3	80.7
Merko	79.0	78.6	79.3
Nodule bacteria	66.0	78.1	72.1

FIGURE 3. EFFECT OF SEED TREATMENT ON PEA SEED. LEFT—TREATED; RIGHT—CHECK

Results of planting treated and untreated pea seed in autoclaved soil in the laboratory are illustrated in Fig. 3. The dust used was Semesan Jr. Similar results are not obtained with all samples of pea seed. A preliminary survey of the organisms carried by pea seed planted in Iowa has been undertaken. A species of Fusarium occurs commonly but its real significance has not yet been determined.

SPECIFIC DUSTS AND METHODS OF APPLICATION

In general, mercury dusts have been used most extensively but copper, zinc and formaldehyde dusts have also been tested. Red oxide of copper has been used experimentally by Horsfall (5) on many kinds of vegetable seeds with some beneficial results. Copper carbonate and formaldehyde have long been recommended for the control of certain smuts of cereals, sorghum and millet. None of the copper, zinc or formaldehyde dusts tested by this laboratory has proven effective for the control of seedling blights of cereals caused by *Gibberella saubinetii* and related species of Fusarium or those caused by *Helminthosporium sativum*. Volatile, organic mercury compounds such as ethyl mercury chloride and ethyl mercury phosphate have proven effective not only for the control of seedling blights but for smut control as well. New Improved Ceresan, one-half ounce to the bushel, is a satisfactory disinfectant for wheat, oats, barley, flax and sorghum. Merko, Barbak III and New Improved Semesan Jr., are recommended for the treatment of corn at the rate of two ounces per bushel, which is about the quantity of dust that will adhere to the kernels in a bushel of seed.

In field practice it is easy to treat small grains with New Improved Ceresan at the recommended rate of application which is one-half ounce per bushel, but in laboratory practice it is impractical to use the dust on small samples at the required rate. Experiments show that five per cent ethyl mercury phosphate may be diluted by adding four parts of talc, gypsum or button dust to one part of the ethyl mercury phosphate, which gives a one per cent dust. The average field germination of five varieties of barley was increased from 58.8 per cent for the untreated to 76.4 per cent when treated with ethyl mercury phosphate diluted to one per cent with talc. For laboratory use, dilution of one part New Improved Ceresan with four parts of talc is recommended. Seed to be treated may be placed in bottles, a slight excess of the diluted dust added and the bottle may be shaken either by hand or rotated on a special machine consisting of two rollers one of which is turned by a small electric motor (Fig. 4). After treatment the excess dust should be screened off

FIGURE 4. LABORATORY MACHINE FOR TREATING SEEDS WITH DUST DISINFECTANTS.

by shaking the contents from each bottle in a tea strainer. The treated samples should be placed in an envelope and held 24 hours before planting to prevent mercury poisoning. If an immediate planting is desired, the treated

sample may be placed for 40 to 60 minutes in an incubator set at 40° C. Tests with several varieties of wheat and barley indicate that the response of samples so treated is similar to that of samples held 24 hours at room temperature.

MERCURY POISONING

The toxic effect of copper and mercury dusts has been observed in experimental trials with seed treatment of corn and cereals for many years by Dr. C. S. Reddy of the plant pathology staff of Iowa State College. The writer has used organic mercury dusts on corn since 1927 and on small grains since 1930. In the laboratory, injurious effects of ethyl mercury chloride were noted in 1931 on barley. The short, thickened plumules of wheat as illustrated by Crosier (1) are fairly typical of the response of corn, wheat, barley and oats when an excess of mercury dust is used (Fig. 5). Sass (15) has found that

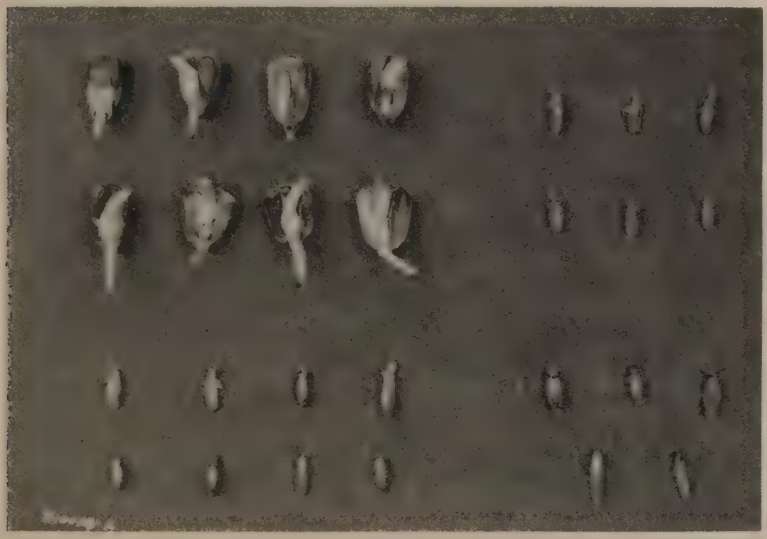

FIGURE 5. EFFECT OF EXCESS OF ETHYL MERCURY PHOSPHATE ON SEED GERMINATION. UPPER LEFT—CORN; UPPER RIGHT—WHEAT; LOWER LEFT—RYE; LOWER RIGHT —BARLEY AND OATS.

seedlings which exhibit mercury poisoning have thickened leaf primordia with irregular crenations and lobes. Cell division is inhibited, the existing cells becoming greatly enlarged and multinucleate either with small nuclei or with large "giant nuclei" which are polyploid. The multinucleate condition is caused by incomplete mitosis.

The conditions which cause poisoning are not known but it may be of interest to note that samples which show mercury poisoning in the laboratory do not always display the same condition in the field. Samples of oats, barley and wheat, both treated and untreated, have been tested in this laboratory and held for two years in envelopes and cloth sacks. No appreciable decline

in germination has been noted for either treated or untreated seed, nor has mercury poisoning been serious after such storage unless it was exhibited at the beginning of the test. The effect of volatile organic mercury compounds on seed stored in large quantities, however, may be decidedly different from that on small laboratory samples.

WHEN SHOULD SEED DISINFECTANTS BE USED IN A SEED LABORATORY?

In the preceding pages data have been presented to indicate that for certain crop seeds the effect of seed treatment on laboratory samples is similar to the effect in the field. It is questionable how far a seed laboratory should go in adopting seed disinfection as a regular procedure in laboratory practice. The work required is more than doubled for the samples so treated because both treated and untreated lots must be tested. Obviously, if samples of cereals contain smut spores the report need show four items, viz., (a) the purity percentage composition, (b) the germination percentage, (c) the presence of smut, and (d) the recommended treatment. When non-systemic pathogens such as dry rot fungi of corn and seedling blights of cereals are present, the beneficial effects of seed treatment are dependent on the degree of infection and the environmental conditions which prevail during the period of germination and seedling development.

Field surveys during each growing season or critical examination of seed samples of a given crop which are received soon after harvest will be of great help in determining the policy for the year. If a disease whose causal agent is transmitted by seed appears in epidemic form it may be necessary only to treat a few samples in the beginning of the testing season and base recommendations for disease control entirely on what previous experiments have shown are warranted. On the other hand, if a farmer or seed merchant receives a report which shows that the germination of his seed can be increased 5 to 20 per cent by seed treatment he will be more likely to treat his seed than if only the presence of the disease is reported.

The present policy in the Iowa laboratory is to treat a portion of all samples of seed corn and determine the percentage germination of both treated and untreated seed. All barley and wheat samples are tested on blotters to determine the percentage of infection with either *Gibberella saubinetii* or *Helminthosporium sativum*. Treated and untreated portions are planted in auto-claved soil to determine not only the percentage strong germination but also the percentage of seedling blight. Certain samples of oats, rye and sorghum are also treated. The service thus rendered is of considerable value in helping to establish seed treatment as a more extensive and permanent agricultural practice.

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PREVALENCE AND SIGNIFICANCE OF FUNGOUS ASSOCIATES OF PEA SEEDS

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Although many diseases of peas have been recorded and the field symptoms adequately described the presence and significance of organisms associated with the seeds have received only incidental attention. The Ascochyta blight of peas has been known for centuries, and the seed-borne nature of the disease noted repeatedly. It remained, however, for studies and compilations made as late as 1927 to emphasize this relationship and its bearing on the disease. The organisms responsible for this, and closely related diseases, when present on germinating seeds, can be observed easily and identified positively. The seed-borne nature of several other fungous pathogenes of peas is recognized but their identification has been found somewhat difficult.

In an admirable attempt to record all of the important seed-borne pathogenes Orton (7)[1] lists 5 pathogenic fungi, 1 saprophytic fungus, 4 bacteria, and 1 virus and since the appearance of this compilation reports have been made of other pea seed associates. Recent bulletins by Harter et. al. (4) and Brown & Evans (1) contain discussions on the control of pea diseases. The writers comment that certain of these troubles are seed-borne and suggest that disease free seed be used. The rates of occurrence and descriptions of these organisms on germinating seeds, however, have been neglected.

Careful examinations of 6,500 samples received by this laboratory since 1932 indicate that emphasis should be placed on a few organisms and the others regarded as probable, but not common, associates of the seed. The presence of a few pathogenes, such as bacteria and viruses, have been demonstrated but only by technical studies not applicable to a routine procedure. Causative organisms of the Ascochyta complex namely, *Ascochyta pisi*, *Ascochyta pinodella* and *Mycosphaerella pinodes* occur annually in several samples of seed, especially in those received from Eastern United States, Eastern Canada, and England. Seedstocks produced in the Palouse district

[1]Numbers in parenthesis refer to Literature Cited.

of Washington and Idaho are protected climatically from development of these fungi and now are commonly used as seedstocks throughout the United States.

Affected seeds are not detected easily in their dry condition. Ordinarily a slight to extensive lesion is formed, which may be sunken or flush with the surface, firm or spongy and only slightly discolored to definitely light brown. Fine dense, white mycelial growths develop from the diseased seeds after 4 to 7 days in germination. Within 10 days the fruiting bodies or pycnidia are evident as minute, (100–280 microns in diameter), circular slightly erumpent dark brown structures. They usually occur under the mycelium and to be studied the mycelium must be rubbed away. The exudations from, and collection of salmon or carrot-red spores over, the pycnidia increase the ease of detection of these fungi. Age of the seeds has no relation to occurrence of the *Ascochyta* spp. Affected seeds of Canada field peas were germinated after 3 years storage in our laboratories. Vigorous mycelial growths developed in approximately the same percentage of seeds as originally. These fungi are correctly considered the most important seed-borne pathogenes of peas. Their presence should be noted and reported since they may occasion severe losses in the field.

Various pathogenic species of Fusarium are associated with pea seeds. These associations have been cited in recent publications by Snyder (8), Jones (5), and Kadow & Jones (6), and Brown & Evans (1), and Crosier (3). Detection in the germinator is not difficult since copious, fluffy white to pink or red fungous growths develop. A pinkish coloration positively identifies this genus. The pure white mycelial masses differ from those of *Ascochyta* spp. in that they are fluffy instead of being compact. Moreover definite fruiting structures are never formed. A microscopic examination reveals 0 to 5 septate, slightly to definitely curved spores, usually 27 to 45 X 4.5 to 5.5 microns. Spores of the *Ascochyta* spp. are either 1 or 2 celled, are never curved and rarely exceed 15 X 4.5 microns in size.

The significance of Fusarium affected seeds varies with the species involved. At least four extremely pathogenic species are associated with pea seeds but according to a recent report by Kadow and Jones (6) their transmission, while an actuality, is exceedingly low. On the other hand an unknown number of saprophytic or weakly-pathogenic species are seed-borne and it now appears certain that they are of common occurrence. Their presence signifies that the seed was produced under moist conditions and hence may not be of the highest germination. Affected seeds often give rise to weak seedlings and in the germinator these either may fail to develop or may rot thus rendering germination counts difficult.

During the past year many samples of peas produced in New York have been found to contain appreciable percentages of Fusarium affected seeds. Evidences of a weak pathogenicity were observed in several samples and later studies appeared to substantiate and to clarify these observations. Many of the Fusarium inhabiting seeds were either dead, extremely weak or harborers of other saprophytes. These observations are paralleled by those of former years and strongly indicate that germinator tests containing 2 per cent or more of Fusarium affected seeds represent peas not produced in the Western United States seed region. Furthermore, the presence of other fungi, such as *Ascochyta* spp. or *Alternaria* spp., in the tests offer positive substantiation that the seeds were produced under humid conditions and they should not be used for seeding purposes.

The Fusarium growths are isolated easily from diseased seeds and can be cultured on any ordinary agar medium or steamed cereal seeds. A collection of such isolations was assembled in 1934 and grown on wheat grains. Unfortunately cultures of the pathogenic species, *Fusarium martii pisi*, *F. orthoceras pisi*, and *F. merismoides* were not included. Strains of *Rhizoctonia solani* were available. Disease free seeds of five varieties of peas, Alaska, Alderman, Gradus, Laxtonian and Surprise, were placed in pots containing sterilized soil to which the Fusarium inhabiting grains had been added. The pots were held at 24°C, a temperature very favorable for root rot development. When nearly mature the percentage of emergence, the degree of wilting, root rotting and relative vigor of the plants were determined and these data were compared to those obtained from the control and the *Rhizoctonia solani* infested pots. The percentage of seeds which produced normal plants are shown in Table 1.

TABLE 1.—*Relation of Fusarium spp. to stands of peas.*

Isolation No.	Percentage of seeds which produced normal plants					
	Alaska	Alderman	Gradus	Laxtonian	Surprise	Average
137	80	80	60	100	90	82
141	90	80	80	80	80	82
144	70	60	90	60	70	70
147	00	50	20	30	40	28
148	70	30	50	50	80	56
150	40	50	50	50	40	46
151	70	40	20	40	50	44
154	80	60	30	80	70	64
155	90	60	50	70	80	50
156	70	60	90	80	70	74
157	70	20	60	40	30	44
162	70	50	60	70	70	64
165	60	70	90	90	60	74
166	40	30	40	50	50	42
Average	64.3	52.9	56.4	63.6	62.9	60.0
Control	80	90	90	80	80	84
Rhizoctonia solani	00	30	30	40	00	20

Similar but better controlled experiments were conducted in 1935. Recent isolations of 17 Fusarium strains from both eastern and western United States seed, 2 strains of *Rhizoctonia solani*, 1 of *Sclerotium* sp., 1 of *Ascochyta pisi*, and 1 of *Botrytis* sp. were cultured on wheat grains and later added to sterilized soil in formalin dipped pots. Fifteen seeds of either Alaska or Surprise peas were placed in each pot of this soil-wheat grain mixture. Care was exercised to maintain a fairly uniform temperature of 24°C and a desirable soil moisture content. When 30 days old the plants were counted, the tops removed and weighed. The results are given in Table 2. Since all of the pots were treated identically, except for the fungi added, it appears certain that the two strains of *Rhizoctonia solani* are extremely pathogenic and that several strains of *Fusarium* spp. as well as the *Botrytis* sp., are effective in reducing germination. It should be noted, however, that the seeds were placed in substrata of contaminated wheat grains which presented an excellent opportunity for seed decay.

TABLE 2.—*Effect of fungous seed associates on emergence and growth of Alaska and Surprise peas.*

Genus of fungus	Number of seedlings emerged in each pot						Green weight (grams) of tops in each pot					
	Alaska			Surprise			Alaska			Surprise		
Fusarium.....	10	13	—	12	12	15	27.0	38.0	—	33.6	34.4	—
Fusarium.....	7	7	—	14	6	6	23.6	26.4	—	36.9	15.6	17
Fusarium.....	7	7	—	7	8	—	12.2	16.5	—	22.6	19.9	—
Fusarium.....	13	15	—	13	12	—	42.9	36.4	—	34.7	33.9	—
Fusarium.....	14	15	—	1	10	—	38.6	38.3	—	2.0	31.5	—
Fusarium.....	13	14	—	15	15	—	43.7	40.3	—	42.1	42.6	—
Fusarium.....	14	13	—	9	14	—	38.2	26.5	—	20.0	34.8	—
Fusarium.....	15	12	—	14	11	—	47.3	41.2	—	37.6	32.2	—
Fusarium.....	13	12	—	15	14	13	0.1	30.6	—	41.0	40.6	30.3
Fusarium.....	9	10	—	11	—	—	27.1	27.4	—	28.8	—	—
Fusarium.....	5	1	—	1	3	—	8.2	1.0	—	.3	4.3	—
Fusarium.....	12	14	—	14	12	—	39.4	42.6	—	32.6	39.7	—
Fusarium.....	9	2	—	10	4	—	24.9	1.2	—	19.9	7.3	—
Fusarium.....	13	9	—	13	—	—	34.1	20.6	—	33.4	—	—
Fusarium.....	9	11	—	7	9	—	24.7	34.3	—	19.4	19.6	—
Fusarium.....	14	15	11	14	10	—	36.2	43.5	28.8	26.7	24.2	—
Fusarium.....	2	—	—	4	—	—	5.8	—	—	6.8	—	—
Rhizoctonia...	4	4	—	2	4	—	8.6	7.4	—	2.6	6.2	—
Rhizoctonia...	1	1	—	3	—	—	1.3	.9	—	6.2	—	—
Ascochyta....	15	14	—	15	—	—	41.0	43.4	—	42.8	—	—
Sclerotium....	10	15	—	15	14	—	36.7	41.2	—	40.0	43.4	—
Botrytis.....	8	12	—	6	6	—	19.3	30.5	—	16.9	14.6	—
Control.....	14	15	15	15	15	14	44.2	35.5	43.8	43.5	46.3	40.9

Averages for Each Genus

Genus	Seedlings per pot		Per cent emegerence		Weight in grams			
					Per pot		Per seedling	
	Alaska	Surprise	Alaska	Surprise	Alaska	Surprise	Alaska	Surprise
Fusarium.....	10.6	10.1	71	67	30.2	26.0	2.85	2.56
Rhizoctonia...	2.5	3.0	17	20	4.5	5.0	1.82	1.67
Ascochyta....	14.5	15.0	97	100	42.2	42.8	2.90	2.85
Sclerotium....	12.5	14.5	83.3	97	34.0	41.7	3.11	2.87
Botrytis.....	10.0	6.0	67	40	24.9	15.8	2.49	2.63
Control.....	14.7	14.7	98	98	41.2	43.6	2.81	2.97

The average weights per plant indicate that while *Fusarium* spp. and *Botrytis* sp. do reduce the percentage of emergence they exercise no inhibiting effect on the growth of the emerged plants, that *Ascochyta pisi* and *Sclerotium* sp. affect neither the germination nor the growth of the plants, and that *Rhizoctonia solani* not only reduces the germination but markedly inhibits plant development as well.

Immediately after removal of the Alaska and Surprise peas, 25 seeds of either Thomas Laxton or Perfection peas were placed in each pot. Depressions of 1 inch depth were made with a sterilized dibble and a seed dropped into each opening. By this method the seeds were uniformly spaced and planted at the same depth. The pots were held at the same temperature as in the previous test and were watered with equal care. The plants were counted when 20 days old, and the tops removed and weighed. As shown in Table 3

the readings are at variance with those obtained previously. Although the pathogenic effect of the two *Rhizoctonia solani* isolates was evident, the Fusarium isolates generally caused no appreciable diminution in seedling emergence or development. This datum appears to substantiate the deductions based on the first test, namely, that the pathogenic nature of *Fusarium* spp. is expressed only by a reduction in germination and then more clearly when the seeds are subjected to concentrated fungous growths.

TABLE 3.—*Effect of fungous seed associates on emergence and growth of Perfection and Thomas Laxton peas.*

Genus of fungus	Number of seedlings emerged in each pot						Green weights (grams) of tops in each pot					
	Perfection			Thomas Laxton			Perfection			Thomas Laxton		
Fusarium.....	25	25	—	23	23	24	34.0	25.2	—	20.4	26.9	34.1
Fusarium.....	24	24	—	22	24	25	29.1	33.7	—	23.5	30.3	34.2
Fusarium.....	21	23	—	20	20	25	24.3	21.2	—	22.2	29.1	29.6
Fusarium.....	24	—	—	24	—	—	31.9	—	—	32.4	—	—
Fusarium.....	20	—	—	22	—	—	28.4	—	—	34.5	—	—
Fusarium.....	24	25	—	24	24	—	33.6	33.8	—	36.9	36.7	—
Fusarium.....	22	20	—	22	24	—	25.4	24.0	—	33.8	28.4	—
Fusarium.....	23	6	—	24	11	—	32.6	3.4	—	28.8	5.9	—
Fusarium.....	21	23	—	23	22	23	25.0	22.4	—	31.1	28.6	28.0
Fusarium.....	24	24	—	17	—	—	38.8	31.0	—	22.3	—	—
Fusarium.....	24	—	—	24	19	—	25.5	—	—	24.3	25.4	—
Fusarium.....	23	24	—	23	22	—	34.6	34.0	—	33.8	29.8	—
Fusarium.....	22	—	—	23	24	—	28.1	—	—	28.0	31.2	—
Fusarium.....	25	24	—	22	—	—	37.2	34.9	—	30.0	—	—
Fusarium.....	23	24	—	23	23	—	36.6	40.2	—	36.0	32.5	—
Fusarium.....	25	24	21	22	25	—	32.2	35.8	38.5	40.2	32.6	—
Fusarium.....	12	—	—	18	—	—	12.6	—	—	15.8	—	—
Rhizoctonia...	0	3	—	3	3	—	0.0	4.6	—	3.2	1.9	—
Rhizoctonia...	2	0	—	2	17	—	1.6	0.0	—	1.5	20.0	—
Ascochyta....	22	—	—	24	20	—	33.2	—	—	27.5	20.5	—
Sclerotium....	24	22	—	25	24	—	39.2	34.2	—	37.4	35.0	—
Botrytis.....	25	—	—	17	20	—	37.6	—	—	17.3	26.4	—
Control.....	24	24	25	22	23	21	37.4	36.8	32.8	32.3	29.7	24.4

Averages for Each Genus

Genus	Seedlings per pot		Per cent emergence		Weight in grams			
					Per pot		Per seedling	
	Perfection	Thomas Laxton	Perfection	Thomas Laxton	Perfection	Thomas Laxton	Perfection	Thomas Laxton
Fusarium.....	22.4	22.3	89.6	89.2	29.6	29.1	1.28	1.41
Ascochyta....	22.0	22.0	88.0	88.0	33.2	24.0	1.51	1.09
Sclerotium....	23.0	24.5	92.0	98.0	36.7	36.2	1.59	1.48
Botrytis.....	25.0	18.5	100.0	74.0	37.6	21.9	1.57	1.18
Control.....	24.7	22.0	97.3	88.0	39.0	28.8	1.60	1.31

Several isolates of *Fusarium* spp. have been cultured on potato-dextrose agar in flasks. Disinfested pea seeds were added when the agar surface was covered with mycelium. The injury to the developing seedlings varied from a slight flecking of the plumules to killing of all of the plants. Usually the

symptoms of pathogenicity were expressed as a slight rotting of the roots, as mycelial development in the tips of the plumules or as a destruction of the sprouts as they emerged from the cotyledons.

Hyphae from the same cultures were inserted into punctures in the plumules of six day old pea seedlings. They were held in a humid atmosphere at 25°C for a period of seven days. Every isolate induced definite injuries usually as small lesions involving a portion of the plumules but in a few instances as a complete rotting and separation of the sprouts.

The association of other fungous pathogenes with commercial seedstocks is too infrequent to permit their statistical treatment. *Rhizoctonia solani* and *Sclerotinia sclerotiorum* have been observed in a few occasional samples. That *R. solani* does occur in pea seeds is now an established fact although Orton (7) omits any reference to this association. The importance of this fungus on seedstocks can be considered inconsequential since its distribution is almost universal and its introduction into pea fields rarely threatens the value of the crop. From the fact that *R. solani* infected seedstocks almost invariably carry *Ascochyta pisi* growths as well it can be deduced that the fungus enters the seeds under humid conditions and that the dry western areas produce disease-free seedstocks.

Identification of this fungus on germinating seeds is facilitated by its brown color, its extremely rapid growth and the lack of any spores. Infections are rarely overlooked since the mycelium arising from a diseased seed quickly spreads to adjacent, or even to all of the seeds in the paper doll. In a microscopic examination it will be found that the branching of the mycelium is always at right angles, that the hyphae is non-coenocytic and that spores are absent.

The pathogenicity of *R. solani* and the virulence of isolated strains is illustrated well in Tables 2 and 3. One isolate from bean seed, 1 from vetch seed, 1 from greenhouse soil, and 5 from pea seeds were used in another seedling emergence experiment. The percentages of emergence varied from 0 to 55 as contrasted to 85 for the controls. The growth of the seedlings in the control pots was more rapid and average green weight per plant was significantly greater.

Mycelia from each of these strains was introduced into developing pods. Infections were very frequent and each of the isolates was recovered from several ripe seeds. Under extremely humid conditions the pods were destroyed entirely.

Sclerotinia sclerotiorum is a very infrequent associate of pea seeds. Its appearance was noted only twice in examinations of 6,500 samples. Its importance is slight and its presence apparently indicates careless handling of the crop of premature harvesting. It is not a specialized pathogene and is of common occurrence in all cultivated areas. Therefore, the planting value of any seedstock is probably not appreciably lowered by the presence of a few infected seeds. *S. sclerotiorum* can be rather easily identified in the germinator. The pure white color of the mycelium, the rapid growth of the hyphae, the presence of hard black bodies called sclerotia, and the absence of spores serves to make its identification possible.

Plant pathologists have recorded the presence of several other fungous pathogenes on pea seeds. A partial list includes *Septoria pisi* (leaf blotch), *Peronospora pisi* (downy mildew), *Erysiphe polygani* (powdery mildew), *Cladosporium pisicola* (seedling blight), and *Botrytis cinerea* (pod rot). That they occur in commercial seedstocks is not impossible. They have, however,

not been recognized in our laboratory nor have they been reported from any other.

Another class of fungi, namely, the saprophytic associates of dead and decadent seeds, have an important relation to laboratory germination. They are incapable of inducing actual field diseases and hence, logically, cannot be termed pathogenes or disease organisms. Their presence invariably signifies that the seeds are undesirable for planting purposes, since poor germination can be expected under any condition and many seedlings will fail to develop into producing plants. In the humid atmosphere of the germinator several of these organisms are capable of invading and destroying the young sprouts. An accurate reading often is impossible when the seeds are covered with these mycelial growths. The very fact that such a condition does exist, however, is as good a criterion of planting value as the finding of 25 per cent or more of dead seeds. It is essential on the other hand that the seed analyst recognize these fungi as saprophytes and not be tempted to qualify the seedstock as a carrier of disease organisms. Some of the most commonly observed fungi are *Rhizopus nigricans*, *Penicillium* spp., *Aspergillus* spp., *Macrosporium* spp. and *Phoma* sp.

Another common saprophyte is associated with pea seedstocks irregardless of their dead seed content. It has been noted from thousands of samples in our laboratories, and was described (Crosier [2]) as a seed-coat inhabiting saprophyte named *Dematium pullulans*. Repeated pathogenicity tests on plants of many varieties consistently yielded negative results. Mycelial masses develop on the seed coats in the form of dark black spots. They commonly are 1 to 3 millimeters in diameter but may completely envelope the seed. The association of the fungus and seeds appears to be due to harvesting and processing of the pea crop when conditions favor the growth and dissemination of the fungous spores and mycelial segments. Although over 99 per cent of the samples received during the 1934–35 season were spotted in the germinator less than 1 per cent received during 1935–36 contained any infested seeds.

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PATHOGENIC ASSOCIATES OF TOMATO SEED: THEIR PREVALENCE, RELATION TO FIELD DISEASE AND ELIMINATION

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Tomato plants in various stages of growth may serve as suscepts to a number of pathogenic organisms capable of inducing serious diseases. Any reasonable approach toward control of these troubles must be anteceded by a knowledge of the organisms involved, especially their host range, parts of the plants attacked, susceptibility to fungicides, and climatic limitations. Such knowledge has been progressively accumulating for many years until an imposing list of publications can be cited.

Attention particularly has been directed toward dissemination of organisms with seeds. It is now recognized that the production of clean tomato seedlings and fruits follows the use of pathogene-free seed. As explained by Crosier (5)[1], variations exist in the types of fungus (or of bacteria) seed associations. Spores of a fungus may merely adhere to the seedcoats or hairs, mycelium may be present immediately under the seedcoats, or in the embryo or endosperm of the seed, or both mycelium and spores may exist in lesions or as fruiting structures on the surface of the seed but firmly attached or embedded in the seed and merely protruding through the seedcoats. Bacteria are borne either externally or internally.

The nature of the associations of pathogenes with seeds of tomatoes have been studied briefly and certain results will be presented in this paper.

The severity of any disease of plants or of animals is impeded by one set of climatic conditions and augmented by another. This is as true for tomato diseases as for those of any other species of plants. During the past 4 years epiphytotic conditions have favored the growth of several tomato pathogenes and they have created havoc to their suscept. A revival of the late blight disease ruined large acreages in Massachusetts and other northeastern seaboard states and stimulated scientific eradicatory attempts. It was found that the severity of the disease often depended on the transplantation of plants produced from diseased seeds. Plants developed from seed which had ripened in disease free fields rarely were blighted. When seed collected from blighted fields, however, was planted in the open late blight became epiphytotic. Examinations of the seed revealed the presence of both internal and external mycelium of *Phytophthora infestans;* indisputable evidence that the disease was a problem of seed control.

According to a list of seed-borne parasites by Orton (10) 14 pathogene associations with tomato seed actually have been proven or logically assumed on the basis of irrefutable observations. Since this compilation proof has been presented by Kadow (8) and Boyd (1) of the seed transmission of two other fungi. Kadow secured seeds from selected fruits by the usual fermentation method. Using the surface sterilization method outlined previously by Crosier (5), he demonstrated the presence of *Verticillium albo-atrum*, a fungus causing tomato wilt, in 44 per cent of the seeds. Those of eggplant vended in packets

[1]Numbers in parenthesis refer to Literature Cited.

also were found to be diseased; an inferential evidence that diseased tomato seed can be distributed commercially.

The importance of the seed carriage of tomato pathogenes recently was emphasized by disastrous outbreaks of early blight, bacterial canker and collar-rot. Canners in New York and other northern states did not harvest the anticipated tonnages of sound fruits. Producers of plants in Georgia also were troubled with seedling diseases and suffered heavy losses of plants.

The necessity for a means of control emphasized field certifications in both the seed-producing and the seedling-growing areas. Northern agencies inspected fields for signs of disease, accepting only those in which early blight and canker were slight or absent. The Georgia State Department of Entomology also enforced for certification of plants to be shipped north a three years rotation including no solanaceous hosts, nor hosts of the root-knot nematode, the use of certified northern seed, and three field sprayings. In addition the fields were inspected and rejected if the amount of disease warranted it. In spite of these requirements northern certified seed on land just cleared of pines or of cotton produced diseased seedlings. In 1935 approximately 30 per cent of the plantings were rejected on the basis of objectionable amounts of disease.

The only uncontrolled factor seemed to be the pathogene-seed association and evidence accumulated in 1935 strongly indicated that commercial seeds were the chief source of all primary infections. A method was developed at Athens to determine the presence of important pathogenes on the seed, and thereby to test the effectiveness of field inspections, of fermentation for bacterial canker, and of chemical (mercury bichloride) seed disinfection. Using the methods employed by Gardner and Kendrick (7), Elliott and Crawford (6), and Kadow (8), 468 samples of seeds received at the Georgia laboratory were examined critically for seed-borne organisms. Approximately 30 to 40 seeds were plated out in each of ten petri dishes with a sterilized spatula. Similar platings were made of treated seed. Supplementary germination and disease counts were obtained from duplicate blotter tests of 200 seed each in a standard water-jacket germinator. Vitality was based on duplicated 200 seed plantings in the greenhouse. The organisms commonly observed were *Macrosporium solani*, *Bacterium vesicatorium* and *Aplanobacter michiganense*, the chief pathogenes on seedling tomatoes. Occasional cultures of *Colletotrichum pomoides*, *Phoma destructiva* and *Fusarium lycopersici* were obtained.

Many species of Macrosporium, or Alternaria, occur on tomato seed principally as saprophytes, or as very weak parasites. The species known as *M. solani* develops a bright red discoloration in an agar plate, usually with much aerial mycelium, and straight immersed hyphae. The mycelium is white at first, but gradually darkens with age. Few spores, and none in chains, form in the seed platings. Proof of the identity of the species was based on comparisons with known cultures of *M. solani* and actual demonstrations of pathogenicity. It has not only been found that seeds do carry this fungus but that other solanaceous plants and soil debris were not responsible in the Georgia area in 1936 for its overwintering and the initiation of primary seedling infections. When pathogene-free seeds were planted in two fields severely blighted the previous year no signs of *M. solani* appeared in 1936.

Massee (9) suggests that tomato seeds carry this fungus and Chupp (4) later established this fact. He stated that when a fruit is infected badly, the fungus mycelium enters the seed and forms a mat under the seed covering. The hyphae also may adhere to the hairs on the surface. Extensive obser-

vations at Athens corroborate this statement. In the average of all tests 1.84 per cent of 14,869 untreated seed were infected. This percentage was reduced to 1.446 in 70,342 once-treated seeds and to 1.01 in 53,433 twice-treated seeds; evidence that both external and internal seed carriage occur in commercial seedstocks.

Evidence for the translation of this seed load into field disease has been found in both 1935 and 1936. One lot of seed, although twice treated showed 1.57 per cent of *M. solani* in plates, and produced a heavy infection on virgin land. The seed showing no infection in plates, also showed none in fields on old or new land. In 1935 only certified seed was required and infection of the collar-rot form reached 100 per cent in some fields. In 1936 treated seed was demanded with the result that nearly every field was certified to be practically free of seedling diseases. While seed disinfection has proved an effective method of producing disease-free plants, several investigators have stated and the Georgia experiments with cuprous oxide and bordeaux mixture prove that spraying and dusting the emerged plants little reduces primary infection.

The two bacterial pathogenes, *Bacterium vesicatorium* and *Aplanobacter michiganense* have been repeatedly obtained in pure culture from commercial seed. There is every indication that these bacteria on the seed seriously hamper the production of certified plants. Seed disinfection with mercuric bichloride effected reductions in the percentages of infection. 1.34 per cent of *B. vesicatorium* developed in untreated seeds, .872 per cent in once-treated seeds and .389 per cent in twice-treated seeds. The percentages of *A. michiganense* for untreated and once-treated seeds were .023 and .0159, but for twice-treated seeds of other seedstocks .0658.

As mentioned above, mercuric bichloride is the most efficient surface sterilizant. Perfect control has been obtained by a 5 minute soak in a 1–3000 dilution in water. Solutions of several proprietary mercury compounds effected good control. However, the dusting of infected seeds with these mercury compounds, with cuprous oxide or zinc oxide gave only negative results. Some commercial concerns secured entire elimination with mercuric chloride, although the period has often been increased to 8 or even 10 minutes. One large company reports that they employ a copper sulphate in water solution unless the mercury bichloride treatment is required for certification as in Indiana and Georgia. They feel that careful fermentation plus the copper sulphate dip is quite efficient. Blood (2) reports that fermentation alone often kills the bacteria in the seed. His observations (3) of plantings from fermented seed supplied by two eastern companies revealed no cankers, although local unfermented seed apparently was infected since field disease was found.

The effect of treatments on seed germination always must be considered. The use of copper sulphate rather than of mercuric chloride on tomato seed is based on earlier experiments showing mercury toxicity and copper tolerance. The more recently stimulated work, however, seems not to attest these reports. Although germination readings at four days indicate a marked decline in vitality of mercury treated seed, readings at seven and ten days prove that this is only a retardation, with practically no permanent injury. The final percentages of germination for 12 untreated lots varied from 83.00 to 98.67, with an average of 89.5, those for 25 once-treated lots from 76.25 to 97.00 with an average of 89.14, and those for 24 twice-treated lots 72.50 to 98.00 with an average of 88.49.

It has been frequently stated that hot water treatment of solanaceous seeds is impractical. Nevertheless, earlier work indicated that *M. solani* might

be reduced by this treatment without injuring vitality of the seeds. The procedure followed at Geneva in treating cruciferous seeds with hot water has been used in tomato seed tests. Seedstocks supplied by canners and also those fermented in the New York laboratory from diseased fruits were held at 50° C for varying lengths of time. Identical time relations were later used at a temperature of 55° C. The results from two typical lots of John Baer seed as shown in Table 1 indicate that prolonged soaking at 50° C little affects germination. Exposure to 55° C, however, does reduce vitality to a greater or less extent depending on the time of treating and the condition of the seed.

TABLE 1.—*Germination of John Baer tomato seeds after treatment in hot water.*

Time of exposure in minutes	Temperature of 50° C		Temperature of 55° C	
	Seedstock A	Seedstock B	Seedstock A	Seedstock B
5	96_1	91_1–4_2	99_1	92_1–1_2
10	97	92 –4	93	94 –1
15	95	93 –4	94	86 –2
20	94	92 –4	96	85 –2
25	96	95 –2	97	85 –3
30	97	92 –2	93	86 –3
35	96	95 –3	90	76 –6
40	97	94 –2	89 –1_2	78 –8
Control	99	94 –0	96	94 –0

$_1$Percentages of normal strong seedlings, $_2$percentages of weak, stunted or slow seedlings.

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THE BETTER SEED PROGRAM OF NEW YORK STATE

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A discussion of the better seed program of this state must necessarily reach back many years. As early as 1882, Dr. E. Lewis Sturtevant, then director of this station in which you are meeting today and to which you have been heartily welcomed, in the first annual report called attention to the great necessity of knowing the breeding and the quality of seed used. He stated that "the subject of germination of seeds is an important one, not only in its relation to the farmer, but as well to the seedsman. The seedsman occupies a position of great importance to the progressive farmer and is deserving of appreciation rather than abuse." It was during this first interest in the germination of seeds that the "Geneva Tester" was designed and first used.

Pedigree in seeds was pointed out as of value. Trial grounds were early used here and Director Sturtevant went on to say that "There is no more important work for a station to carry on along with its more immediate practical duties than one which shall enable this condition of systematic identification of varieties to be fulfilled." It would appear that the fundamental principles of germination work, more recently confirmed, were early recognized since Dr. Sturtevant stated in his second annual report that, "from our experience with duplicate trials in germination, we must deplore the system which shall condemn one seedsman and inferentially endorse another, through variation in the germination properties of seed from single packages sold. That this method may be a just one when practiced on a sufficiently large scale seems probable, but not when undertaken with few samples, and without the check upon our conclusions which are to be derived from duplicates." It was further added that "In using seeds purchased from seedsmen we are continually subject to the liability of a mixture of varieties in the same seed package, and to defects in the vitality of the seeds used."

According to all the records available it would seem that the "commission seed" business in this state has for a long time been one which could not be pointed to with pride since in 1882 the Director stated that; "our experience with 'grocery seeds' that is the packages from boxes distributed to be sold on commission, has been so extremely unsatisfactory that we are fain to believe that it is only the ignorance of the purchaser that retains this abominable system of sale." The following year the Director in reporting upon the packet seed business stated, "It is probably to this system in vogue that we are indebted to the reluctance of many to patronize seedsmen directly and try improved kinds of seed, for those who have been deceived by 'grocery packets' of seed can scarcely be expected to feel encouraged to extend their future attempts to secure change of varieties, or of seed." These are statements made back in 1882 and yet even today we are not at all proud of the performance of a certain few packeters of vegetable and flower seeds located within this state who still enjoy a certain amount of business in this state as well as in

others much to the detriment of the trade in general and certainly that of the reliable seedsmen.

A rather effective program of research work with seeds started in the early eighties, was carried on and produced valuable results dealing with double embryos, mutilation, and regeneration of seeds as well as information as to the size and weight or specific gravity of seeds. At a later date when alfalfa came into extensive use in this state much was done to detect those lots which were dodder seed laden. Perhaps this was the impetus given for legal control since in 1912 the first seed control law was enacted. The initial work of the writer was with the inception of this newly enacted law. It was a unique law in some respects since it required that the percentage of weed seeds be determined by "count" rather than by weight as at present. This was soon changed and then came the Uniform State Seed Law of which the present law is largely a copy.

New York state containing New York City said to be the world's largest seed port, was long the dumping ground of much unadapted imported alfalfa and red clover seed which was finally stopped by the seed staining law. Changes in control aspects have changed from time to time. Control fields were provided for in 1924. Later came the formation of the Cornell Seed Council, and the vegetable seed law in 1930. Farmer seed-growers formed the New York State Seed Improvement Association which has done so much to foster the use of better farm seeds, and has provided for a system of certification. Then in 1934 a change in the vegetable seed law among other things brought the requirement that all parcels of such seeds must show the percentage of germination thereon. This was but one of the many attempts made to stop the sale of low-quality and worthless commission packet vegetable seeds for which we deeply regret certain New York State packeters are noted much to the sincere regret of many reliable seedsmen. Last year the seedsmen and dealers of the state organized the State Seed Dealers' Association. Then just last March the legislature passed an amendment bringing flower seeds under control.

The seed testing laboratory and the control field work together with the research projects was made a separate division autonomous with the other divisions of the station by act of the trustees of Cornell University in May of this year. The work of the Division of Seed Investigations, as the new unit is now known, is divided into five sections dealing with purity, germination, disease, control fields, and research. These you are cordially welcomed to visit today. One of the functions of the division is to furnish the technical laboratory analyses and control field information to the Commissioner of the Department of Agriculture and Markets at Albany who enforces the seed law. This is estimated to occupy approximately one-third of the effort and capacity of the division. The remainder of the output is about equally divided between service to farmers, dealers, growers organizations, and extension effort to the seed buying public. In this extension effort we work very closely with and through the extension specialists of at least four departments of the State College of Agriculture of Cornell University at Ithaca.

In conclusion then, the seed program of this state which is a seed buying state and not a seed growing one, is to place in the hands of planters of seed stocks the best possible kind, variety, and quality of adapted seeds available. Just who will supply these seed stocks commercially depends largely upon the policy they follow for indeed an increasingly large percentage of the farmers are becoming good seed minded. Our problems have not all been easy

of solution nor indeed are they all solved today but we believe much has been accomplished. It is indeed a pleasure to again welcome the association and its friends here today and to be able to show you some of the things we have been trying to do in the way of seed control, distribution, study, and research.

ASSOCIATION MEMBERS AND GUESTS ATTENDING THE MEETING, AFTER ADJOURNMENT AND AS THEY WERE ABOUT TO VISIT THE LABORATORIES AND CONTROL FIELDS.

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